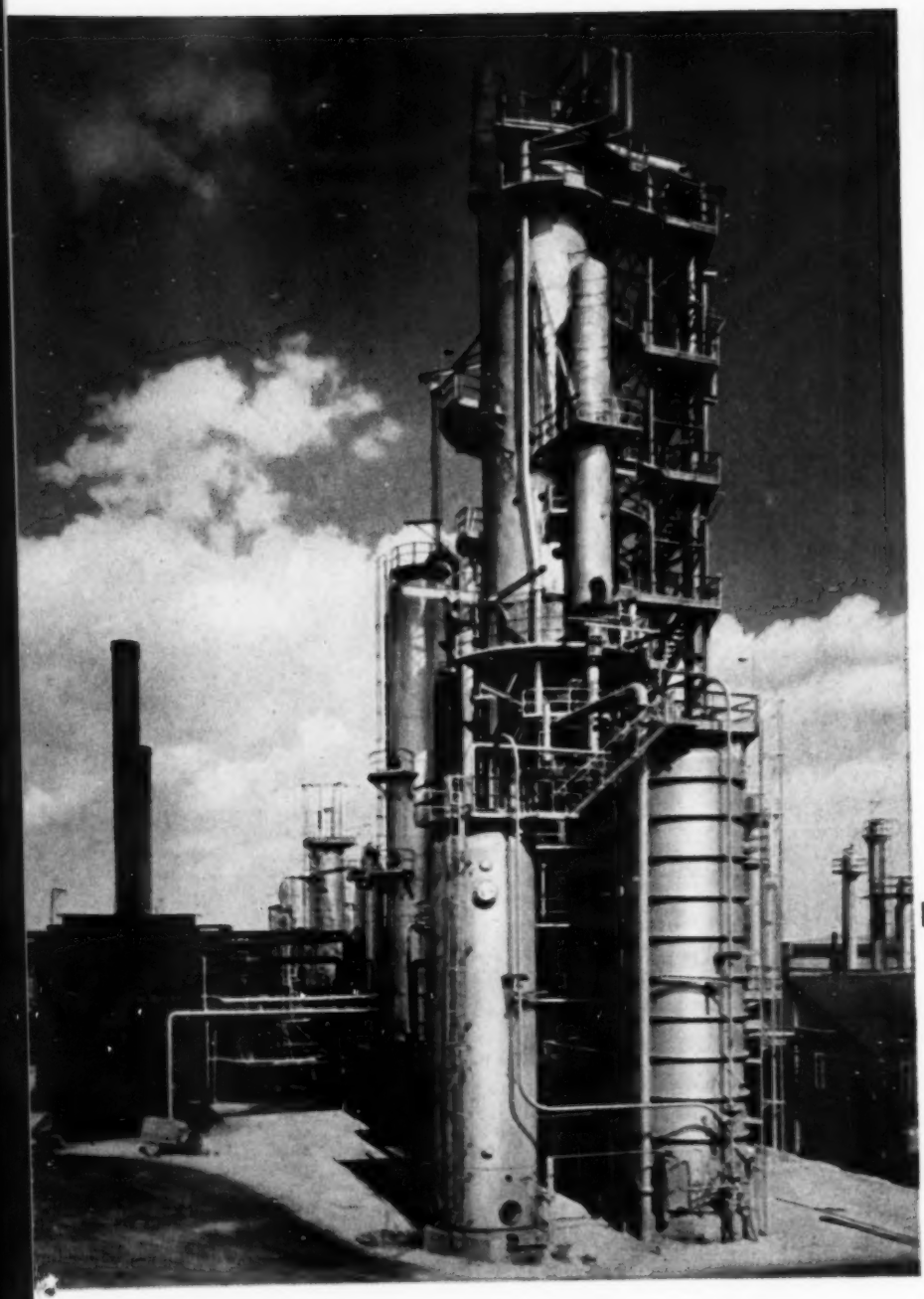
Industry and Power



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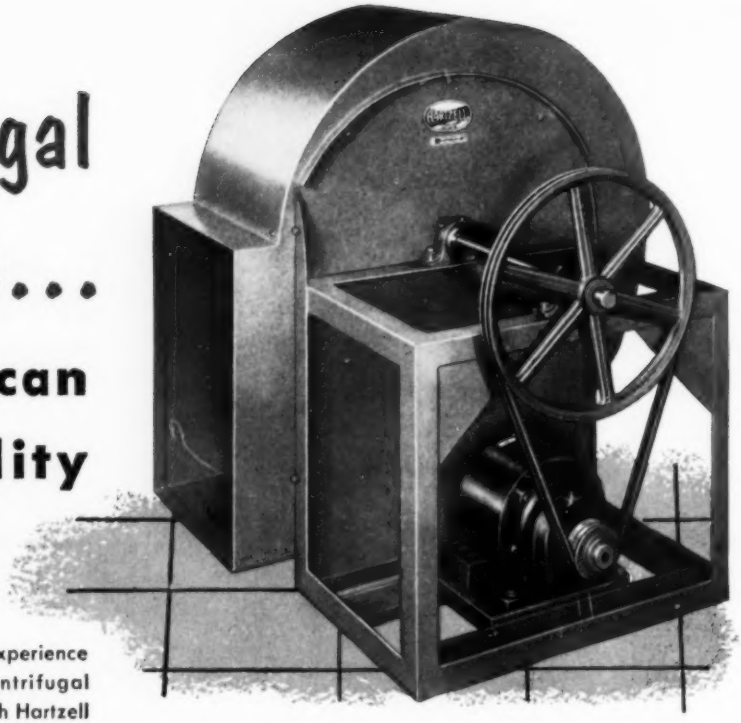
New Centrifugal Blower Line...

Now! Hartzell can meet your utility blower needs



After 27 years of ***industrial*** air-moving experience Hartzell presents their new line of centrifugal blowers. These new blowers, combined with Hartzell propeller-type fans and blowers, round out the line to meet your air-moving requirements

Models to meet practically every industrial need. Belt-drive, direct-drive and special pressure models. Sizes from 4½" to 48". Simple, sturdy, welded-steel construction. Standard and special motors. Speeds to deliver exactly the air needed against almost any pressure.

And they come to you backed by the know-how of your nearby air-minded Hartzell representative.

If you know Hartzell propeller-type fans and vaneaxial blowers you know Hartzell centrifugal blowers ***must*** be good. You know they're built for ***industry***. No divided aim, no compromise with other demands.

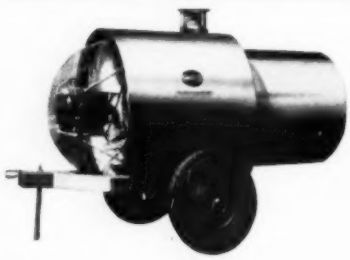
Mail the coupon below, or write for your copy of our new centrifugal blower catalog B-10. It's packed with information.

PROPELLER-TYPE FANS

The famous Hartzell propeller-type fan is made in every conceivable type, from the single-propeller model shown to multiblades, extension-shaft, utility and others.

VANEAXIAL BLOWERS

If you want a powerful blast of high-speed air against pressure, check this blower. Made in belt-drive and direct-drive models, in a wide range of sizes.



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For cold-weather cement laying, heating of large structures under construction and other temporary, shifting needs for large volumes of heat, distributed under high pressure, the Hartzell Hotblast is ideal. Made in 3 sizes—3, 5 and 7½ HP heat-distributing fan—producing hundreds of thousands of BTU. Equipped to burn oil or gas; with electric motor or gasoline engine. Mounted on an all-welded two-wheel trailer. Economical operation, plus powered heat distribution. Write for complete information.

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SERVED 8,520 HOURS—
double ordinary V-Belt Service

MATCHED set of eleven Hy-T V-Belts by Goodyear installed on oil field pump delivered 8,520 hours' service after specification for drive by G.T.M. —Goodyear Technical Man.

Ordinary V-Belts on adjoining similar drive failed in ½ the time. Comparison shows added belt life of Hy-T Belts, thanks to special design featuring synthetic material in reinforcement for high strength and low stretch. Write Goodyear, Mechanical Goods Division, Akron 16, Ohio.

YOUR GOODYEAR DISTRIBUTOR *can quickly supply you with Hose, Flat Belts, V-Belts, Packing, Tank Lining, Rubber-Covered Rolls. Look for him in the yellow pages of your Telephone Directory under "Rubber Products" or "Rubber Goods."*

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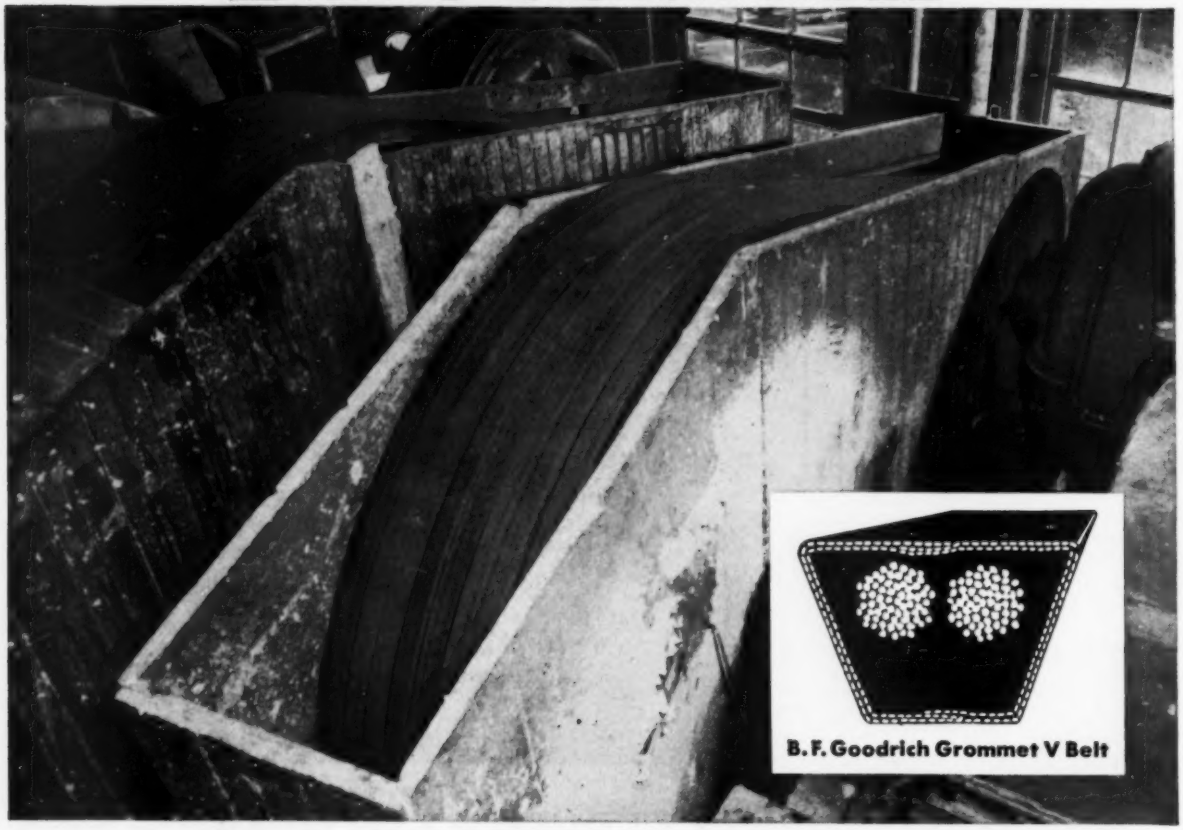
RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER



11 to 1 service record proves B. F. Goodrich belts last longer

User reports 3-way saving with grommet V belts

ORDINARY V belts on these drives lasted only a year. They couldn't take the 24-hour-a-day service, the heavy loads. Covers would separate from the belt, flap around the drive, get caught in pulleys, then tear off completely. Then a B. F. Goodrich distributor recommended grommet V belts. It proved to be a perfect solution. Installed in 1941, both sets of grommet V belts have already lasted 10 times longer, and still look good for years' more service. Here's why BFG grommet belts outlast and outperform ordinary belts:

No weak spots

The section where cords overlap is the weak spot in ordinary belts. That's where 85% of belt failures occur. But in B. F. Goodrich grommet V belts this cause of belt failures has been eliminated. All of the cord material in a grommet belt is *concentrated* in twin grommets. These grommets are cord loops, made like giant twisted cables except that they're endless. There are no splices or overlaps—no weak spots to cause premature belt failures.

Better grip, less slip

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor. Because there is less slip, there is also less surface wear.

Save 3 ways

This company, like many others, is making a 3-way saving with grommet V belts. First, they save on replacement costs because grommet belts last longer. They save on production costs with no shutdowns caused by belt failures. And they save on maintenance costs because these belts need less attention. Yet the savings they make are clear profit because grommet belts cost not one cent more than ordinary V belts. Next time you need V belts, order *grommet* V belts from your BFG distributor. *The B. F. Goodrich Company, Industrial & General Products Division, Akron, Ohio.* (*Available in Canada*).

Grommet V-Belts BY
B.F.Goodrich
FIRST IN RUBBER

Industry and Power

VOLUME 64 **April 1953** NUMBER 4

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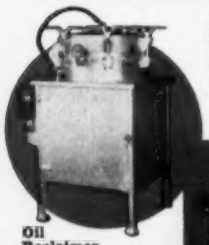

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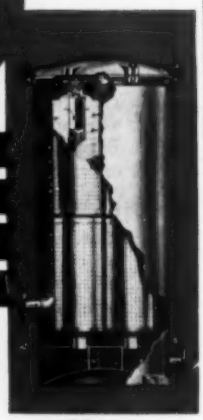

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Faster X-Ray Pictures

• Electrical research has found that under certain conditions fluorescent screens are capable of a highly discriminating brightness response to two million ev X-rays. Inspection of melt loaded ammunition may be speeded if the technique is teamed with rapid automatic film processing. Energy of the high voltage, steel penetrating X-rays is greatly in excess of the usual peak response energy for fluorescent screens. The proposed fluorographic technique will probably supplement present methods of X-ray inspection and show the way to lower cost and faster inspection.

Slow Slow-Motion Films

• If motion pictures, taken at 3,500,000 frames per sec, are projected at the normal rate of 16 frames per sec, the time factor of the event pictured is tremendously amplified A new ultrafast camera has been developed by the University of California's Los Alamos Scientific Laboratory to handle such extremely slow-motion. It is a continuous writing, rotating mirror type camera to be used for recording high speed events that are self-luminous or can be illuminated by very intense, explosive light sources.

Plastics Cargo Tanks

• The long promised use of plastics as a popular structural material has received impetus by recent developments and by applications in the automotive and aeromotive fields. Now the news is that trucks used in the desert may have cargo tanks made of a new glass-fiber polyester plastic. The plastic tanks weigh less than a third as much as those made of steel, and they resist corrosion and fungus.

Progress of Nuclear Power

• The general situation on nuclear power as reported by the Armour Research Foundation, indicates development of nuclear reactors to produce power is in the works but progress is slower than scientists hoped. Eleven new companies have joined Dow Chemical and Detroit Edison in assigning one or more men to work full time in joint study with the Atomic Energy Commission. First installations probably will be in areas with high fuel cost. Relaxation of restrictions on commercial exploitation of nuclear energy is on the legislative calendar.

Congress is studying ways to finance nuclear power plants. Proposed methods are (a) the government would subsidize private industry by buying plutonium as a byproduct of power; (b) private industry would proceed without subsidy; and (c) the government itself would build plants. The last solution is unlikely and industry disagrees on the desirability of a subsidy.

Hot Funeral for Atoms

• Patent No. 2,616,847 covers a method for disposing of radioactive fission products which are in a solution. The solution is brought into contact with a dried cation exchange mineral consisting principally of montmorillonite, bentonite, and fuller's earth which will absorb the radioactive fission products. The mineral is then heated to a temperature between 705 and 1100 C and buried.

Cold Fluid Flow Control

• Patent No. 2,619,107 discloses a control system for automatically regulating the supply of a liquid medium, such as liquid nitrogen, to a cooling trap. The system is responsive to the level of liquid in the trap, and motive power for actuating the device is supplied by the vapor pressure of the liquid being controlled.

The Big Shake

• Construction of a new, high capacity vibrator, believed to be largest testing device of its kind, has recently been announced by the Navy. It can hold a 6000 lb load on a 5 x 6 ft table, and has a maximum reaction force of 50,000 lb. Although weighing 4 ton, it is easily moved on casters. Advantages include remote control, greater accuracy of vibrations, and ease in changing amplitude.

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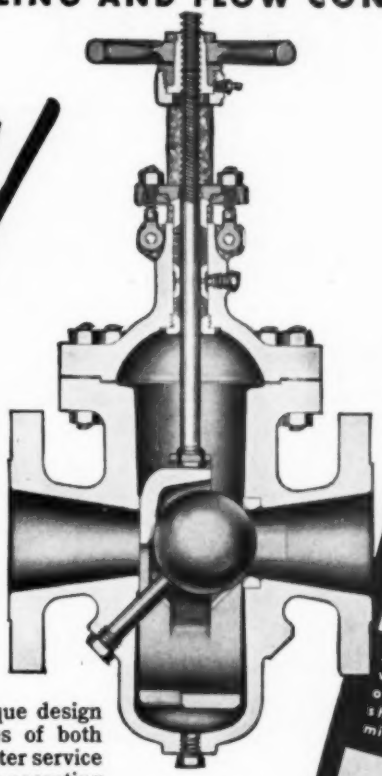
Venturi-Ball
VALVES

(Patented and Patents Pending)

CAST STEEL OR CRANE 18-8Mo ALLOY

Outside Screw and Yoke—Flanged. Available with sliding stem for assembly with power operators.



Fully closed with ball disc locked in outlet port. Ball seldom seats in same position, thus minimizing wear and erosion.
Smooth opening begins when ball cage "rolls" ball out of its seat. Crescent shape opening permits minute throttling.
Inclined surfaces in the cage lift the ball disc clear of the seating surface.
Fully opened with U-shaped bottom of cage bridging the gap in body to form a continuous flow passage.

Meet the Crane-Paul Valve—a unique design that combines desirable advantages of both gate and globe valves. It provides better service and longer life under more rigorous operating conditions than such valves normally stand. These features include—

Exceptionally accurate throttling with a minimum of wear and erosion, resulting in long-lived seating surfaces.

Straight-through, non-turbulent flow—with pressure drop characteristics approaching those of venturi-type gate valves.

Smooth, easy response throughout the entire range of operation.

Completely tight shut-off.

Heart of this new Crane-Paul Valve is a precision-ground ball disc which rides loosely in a cage direct-connected to the valve stem. In operation, the ball is moved to and from the center of flow and rolls into and out of the body seat. At no time during valve operation does the ball spin or chatter, even in closely throttled positions. It revolves just enough to provide a new seating surface each cycle. In the closed position, part of the ball actualiy protrudes into the outlet port where it is tightly seated by the wedging action of the ball cage.

Literature Sent on Request

Full information on this new Crane-Paul Valve is in your Crane 53 Catalog. Literature is available from your Crane Representative or on request to address below.

Cast Steel
150-Pound, Sizes 1 through 6"
300-Pound, Sizes 1 through 8"
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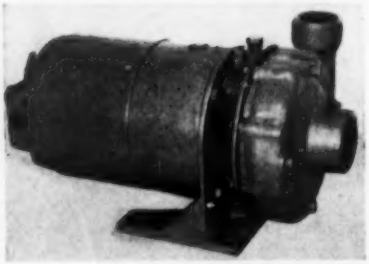
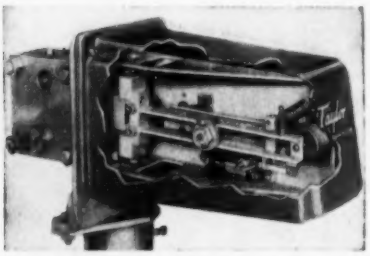


Pump features compact design

D-10 Although designed especially to meet air conditioning requirements, a compact close-coupled centrifugal pump developed by Goulds Pumps, Inc., is said to be well suited for many other industrial applications. The motor and pump form a single, compact unit. The impeller is of the single-suction type, and the case is vertically split for easy inspection and maintenance without disturbing piping connections. Known as the Fig. 3642, it delivers up to 110 gpm, and operates at heads up to 110 ft. Motors range from ¼ to 2 hp. Construction is described in an available bulletin.

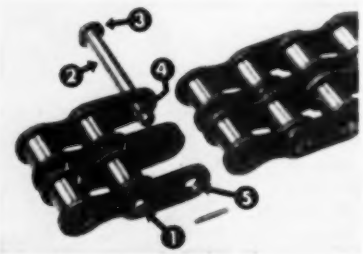


Transmitter simplifies flow measurement

D-11 For close-coupled fluid flow measurement, liquid level measurement, or other applications requiring differential pressure measurement and transmission, Taylor Instrument Companies have developed a force-balance transmitter, known as the Transaire. It can be used to measure flow of liquid, steam, or gas; liquid level; or specific gravity. Essentially, it consists of a primary unit which senses differential pressure, and a secondary unit which transmits proportional output air pressure. Advantages include simplified installation, easier maintenance, simplified adjustments, and a built-in damping device. Operation is discussed in an available bulletin.

Scrubber provides efficient control of stack dust

D-12 Six principles of dust precipitation are combined in the type V multiple-action scrubber, according to the manufacturer, Johnson-March Corp. It is said to provide an unusually wide range of applications and design flexibility, and is capable of removing extremely large volumes of dust. Water requirements and draft loss are low. Applications include rotary dryers, cyclones, kilns, roasters, mixers, and pulverizer exhausts, as well as stacks of asphalt plants, chemical plants, and similar industrial operations.



Roller chain provides easy assembly

D-13 Baldwin-Duckworth Div. of Chain Belt Co. has developed a riveted roller chain described as combining long-wearing characteristics with ease of assembly and disassembly. It is supplied in ASA standard and heavy series, 1 through 2½ in. pitch sizes, and in multiple widths. Baldwin-Rex single pin couplers, installed at convenient intervals, are said to be easy to remove and provide a tight fit throughout the life of the chain.

Valve automatically controls liquid level

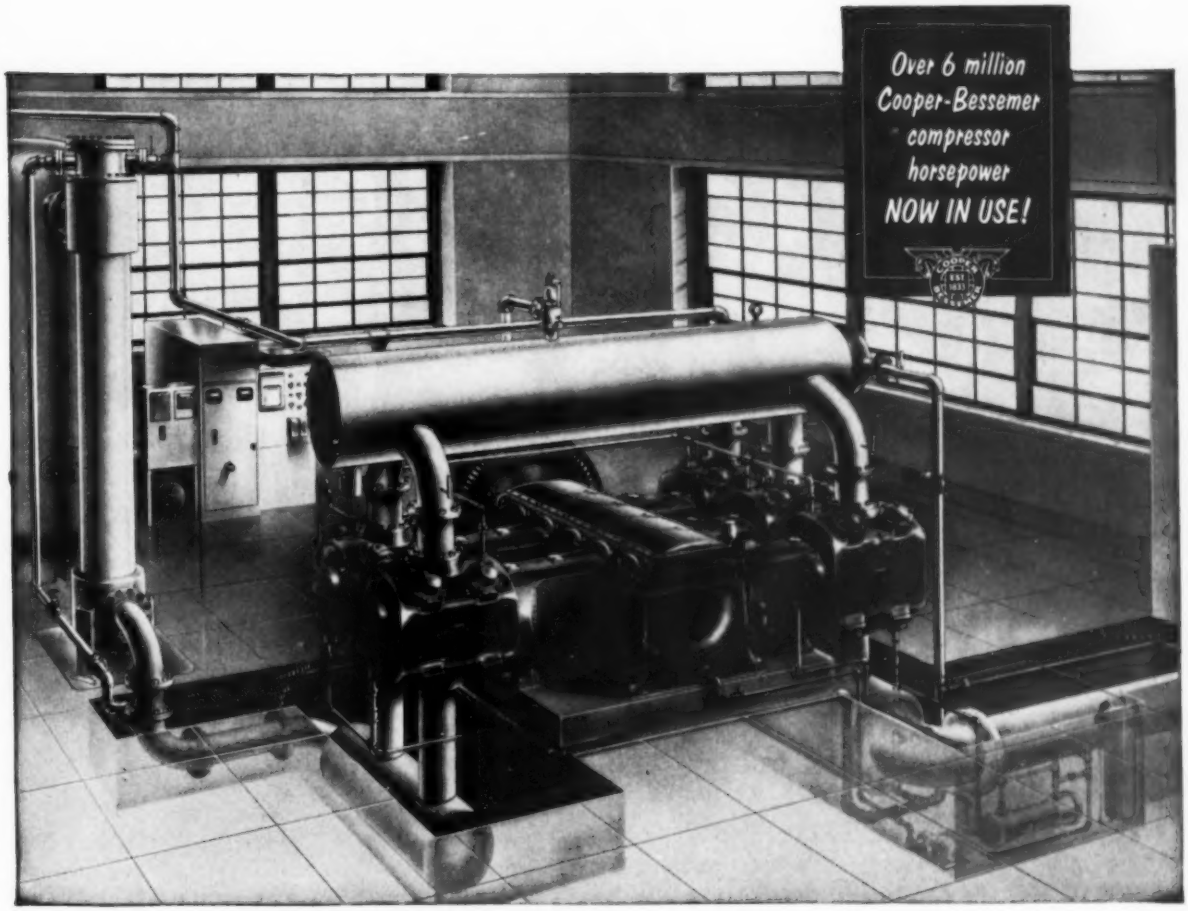
D-14 Many applications in equipment where steady water or other liquid level is to be maintained automatically, are listed for a pressure reduction valve developed by Helco Products Corp. It has been designed primarily to maintain a very low and sensitive outlet pressure, and can be used to replace throat valves wherever a closed system is desirable because of sanitary requirements or corrosive conditions. Operation is with inlet pressure from 5 to 260 psi. Water level can be maintained from 5 to 20 in.

Cylinder-operated valve provides quick opening

D-15 Wherever quick opening and closing is desired, Everlasting Valve Co. has designed a cylinder-op-

(Continued on page 12)

NOTE—Each new product item has a key number for your convenience in asking for additional, detailed information. Insert this number on return post card on page 115



Recommended setup
FOR SHOP AIR AT LOWEST COST!

THE above illustration shows a modern air compressor installation completely equipped with controls capable of functioning efficiently under all plant air requirements.

This opposed-action unit is one of the latest Cooper-Bessemer motor-driven compressor designs and is rated 1,000 hp, delivering 5,000 CFM at 100 lbs. operating pressure. The Cooper-Bessemer opposed-action design contributes to space-saving compactness, vibration-free operation and long life. Note also that in this setup pulsation dampers are located on all suction and discharge lines, and that all controls are localized on a single panel for maximum compactness and convenience. Finally, space requirements, piping and line losses are minimized with a single overhead intercooler.

Whatever your requirements for air, Cooper-Bessemer engineers will be glad to work with you and help you come up with *more air . . . in less space . . . at lowest cost.*

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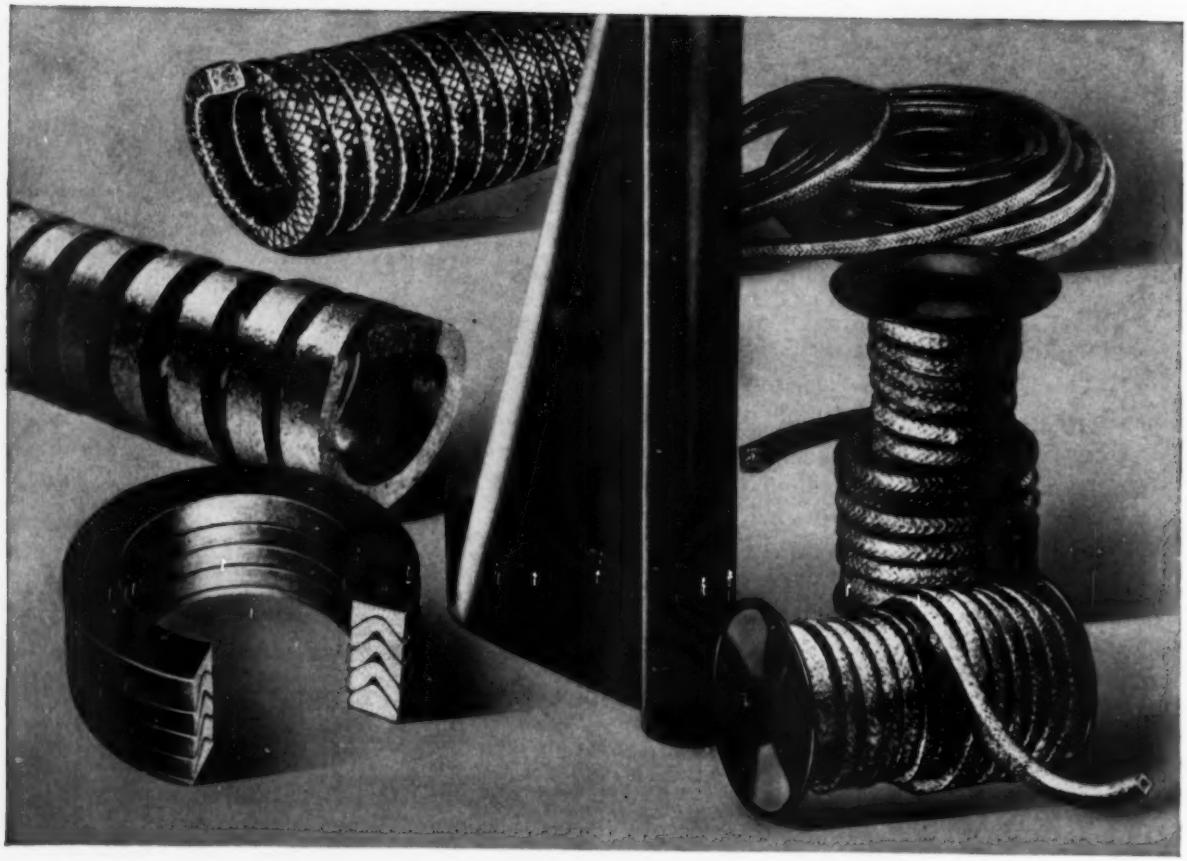

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95% of all packing needs are met with R/M's BIG 7

Lower inventories! Simplify ordering! Reduce downtime!

If you've thought you had to carry 10, 20, 50 different types of packings, forget it! Your plant probably needs only 3 or 4. R/M now has a basic line of *just seven* types of field-tested packings engineered to give custom-built performance in 95 percent of all applications. We call them the "Big 7" R/M Packing Types. To accomplish this engineering feat, R/M called into play 50 years of know-how and experience, and all of the research, testing and production facilities of its seven great plants. Exhaustive field testing has proved that all but the very rarest packing applications can now be met with the "Big 7" R/M Packing Types. Standardize on R/M Packings. You'll get superior performance every time. You'll lower your inventories, simplify your ordering, and reduce your downtime. For details, see your R/M distributor.

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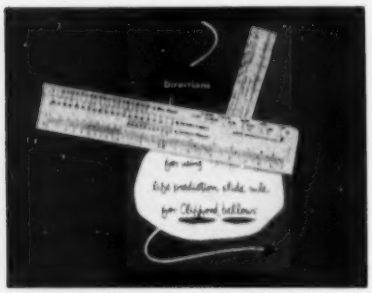
new equipment

(Continued from page 8)

erated, quick-acting valve to permit automatic cycle and multiple operation by one man. It can be actuated by air or other fluid, can be regulated for operation at any speed, and also can be remote controlled electrically or manually.

Plastic coating provides protection and identification

D-16 For use as both protection and color indentification on insulated refrigerant, cold water, steam, and other lines and insulated equipment, Armstrong Cork Co. has developed a tough plastic coating for either brush or spray application. Known as Insulcolor, it may be used over heat insulations, cork pipe covering and lagging, and also as a finish over cork insulated air conditioning ducts. It can be applied over standard asphaltic finishes without danger of bleeding through, and can also be used as an adhesive for pasting down lagging cloths.



Slide rule simplifies selection of bellows

D-17 Clifford Manufacturing Co. has designed a slide rule and table of bellows characteristics which is said to provide a quick, convenient means of selecting the correct bellows for a particular application. The slide rule handles three variables: life expectancy, pressure, and maximum stroke. It also has a conventional C and D scale, a list of decimal equivalents from 1/64 to 1 in., and areas of circles covering the same range. There is also a table showing the total number of cycles per day, week, month, and year, if the frequency per second is known. Also included is a complete set of templates for tracing bellows to be shown in drawings.

Vent valve can be easily disassembled

D-18 For continuous venting where operating pressure does not exceed 35 psi, Hoffman Specialty Mfg. Corp. has developed a hot water main vent valve designated No. 791. It can be easily taken apart for cleaning, or removal of dirt or cleaning compounds. Should substances lodge between the throat pin and seat, the valve cap can be tightened against the gasket to prevent water leakage until convenient to remove valve.

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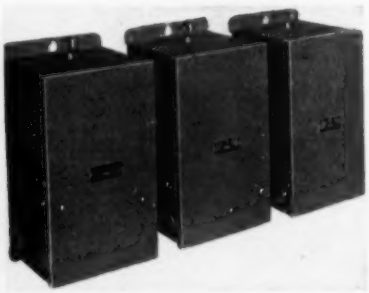


Lighting transformers provide simplified installation

D-19 For quicker, easier installation outdoors as well as indoors, Marcus Transformer Co. has developed a general purpose lighting transformer designated type C. It is available in sizes from 1 to 15 kva, single or three phase, up to 600 v. To permit mounting outdoors, the housing has been designed with a welded steel case, and vents are placed to provide weatherproof ventilation. A self-contained wiring compartment is said to provide greater ease and speed of installation.

Welder is redesigned for stepless current selection

D-20 Stepless current selection from 40 to 375 amp is featured in a 300 amp a-c welding transformer redesigned by General Electric Company's Welding Dept. The unit, designed for practically all types of applications, incorporates an enlarged scale and fine screw adjustment to facilitate current selection. Arc-stabilizing capacitors are said to eliminate popouts, and extra protection against high temperature coil failure is provided by silicone insulation.

Fan offers quiet operation

D-21 New York Blower Co. has developed two fans to meet the demand for small, adjustable speed V-belt units. A slow speed wheel is said to provide quiet operation. Fan speed can be adjusted in the field. Models are designated, No. 76 with upblast discharge, and No. 91, with top horizontal discharge. Capacities, listed in a 4-page bulletin, range from 360 to 1400 cfm.

Remote units tie in with plant annunciator system

D-22 To permit operation of remotely located visual trouble signals as a common, plant-wide, audio-visual annunciator system, Panalarm Products, Inc. has developed an adaptor unit. Individual illuminated nameplates or bullseye lamps are furnished. All signals

(Continued on page 16)

Photomicrograph of one type of silica scale in early formation stage. Further deposits will fill in between the "trees" to form a dense, glass-hard, insulating covering that is extremely difficult to remove—and impervious to usual water treatment techniques.

STONE FOREST

(The boiler scale that fought back)

● When silica scale was mentioned, water-treatment experts used to change the subject quickly . . . until a plant using The Nalco System began having scaling troubles due to high silica content of the raw water.

That was many years ago. Today, the same plant, operating at 135 psi, maintains 500 ppm (29.4 grains per gallon) silica in boiler water without scaling.

The Nalco research program that solved this low-pressure boiler water silica problem is a continuous one, so that today The Nalco System successfully meets the challenge of silica wherever it arises in the field of water conditioning.

Whether your water treatment problem is silica—or something even tougher—Nalco has the solution, or can put the full facilities of the Nalco Laboratories to work on it for you.

LATEST STUDY ON SILICA CARRY-OVER

At operating pressures over 400 psi another silica problem—that of silica carry-over—often arises. One of the 1951 ASME papers, "Correlation of Silica Carry-over and Solubility Studies" is an up-to-the-minute, informative discussion of this problem. You are welcome to a copy. Just write to National Aluminate Corporation.

NATIONAL ALUMINATE CORPORATION

6218 W. 66th Place • Chicago 38, Illinois

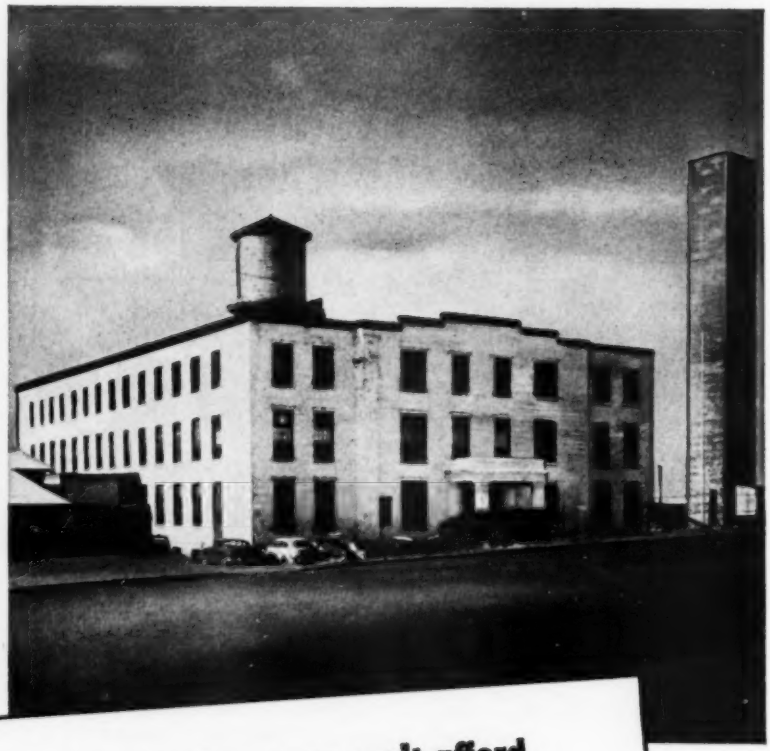
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM . . . Serving Industry through Practical Applied Science

"WE GET BIG SAVINGS THE MODERN WAY!

MODERN COAL-BURNING AND HANDLING EQUIPMENT SAVES THIS PLANT MORE THAN 35% ON LABOR ALONE!

This view shows The Welch Grape Juice Company's plant at Westfield, New York. The power plant consumes an average of 700 tons of coal per month. Modernization consisted of installing new stokers, boilers, controls and coal-handling equipment. This highly efficient equipment not only cuts labor costs, but also saves 18% on fuel. The complete installation will pay for itself in about 6 years.



If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs — *for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

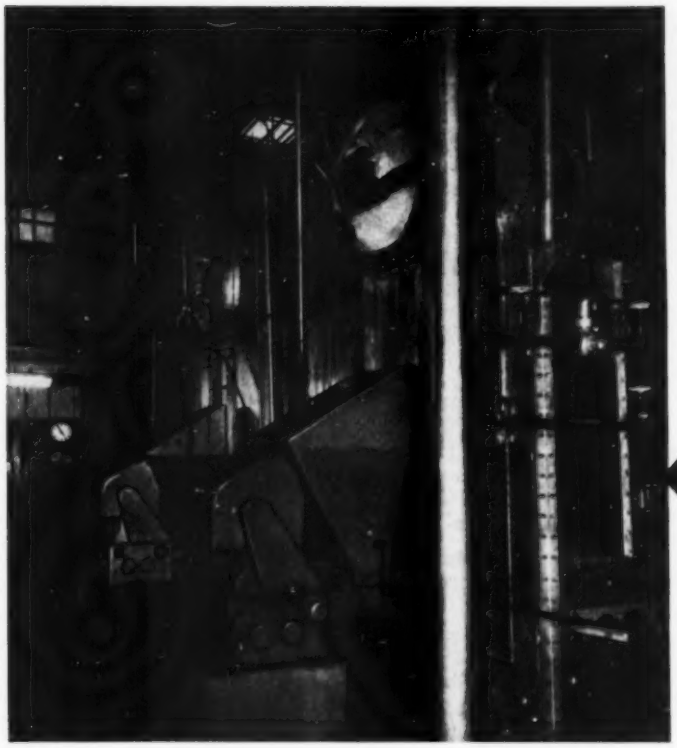
COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more — for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

BY BURNING COAL

Other fuels would cost us far more!"



says
Mr. A. J. Monta,
Plants Engineer,
The Welch
Grape Juice
Company, Inc.,
Westfield, New York

"We analyzed the cost of coal and other fuels before modernizing our power plant. The result is this up-to-date coal installation that delivers steam at half the cost of competing fuels. That's why we say, *for economy you can't beat* bituminous *coal burned the modern way!*"

● Burning bituminous coal the modern way can save you money, too! Labor costs are cut to a minimum with up-to-date coal- and ash-handling equipment . . . modern combustion installations deliver anywhere from 10 to 40% more power from every ton of coal!

That's why, if you're planning to modernize or build a new plant, it will pay you to get the latest facts on coal. Let a consulting engineer show you how a modern coal installation designed to meet your specific needs can save you real money.

What's more, today, bituminous coal customers get a better-prepared product—designed to meet their special requirements. And coal offers future dependability no other fuel can match. Reserves are virtually inexhaustible, and America's coal industry is the world's most efficient—your assurance of dependable supply at relatively more stable prices for years to come.

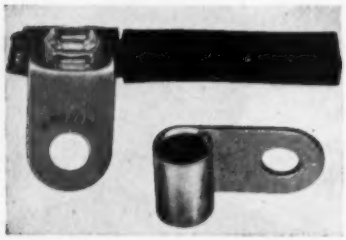
BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

new equipment

(Continued from page 12)

connect to a horn or bell which must be acknowledged when off-normal condition develops. Additional signals may be added to the system simply by inserting plug-in units into chassis receptables. How the system works is described in a bulletin.

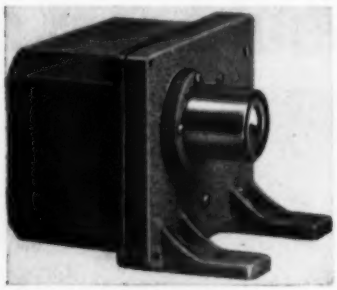


Solderless terminals for heavy duty applications

D-23 Aircraft-Marine Products, Inc. has added flag type solderless terminals to its line of heavy duty power terminals and connectors. Units are available for 8 wire sizes from No. 8 to 4/0. Tongues are designed for a wide range of stud sizes. They may be used with solid, stranded, or irregularly shaped wires.

Magnetic brakes self-adjust for wear

D-24 Fractional horsepower magnetic brakes for all standard a-c or d-c electric motors, with torque readings of 1½, 3, and 5 lb-ft, have been developed by Dings Brakes, Inc. The units self-adjust for wear, but critical adjustment of torque can be made for precisely timed stops. Thermal ratings are 6, 7, and 8 hp sec per min, respectively. Units are equipped with hand release, and mount without dismantling. Weatherproof and explosion-proof types are described in a bulletin.



Photoelectric light source incorporates two filaments

D-26 Positive protection against failure of the photoelectric light source is provided by a dual-filament lamp developed by The Autotron Co. When one filament fails, the other automatically comes on. In addition, a signal light warns the operator. Designated the L4 light source, it also employs an extra low voltage connection for use when distance between light source and photo-amplifier is less than 5 ft, which is said to increase lamp and tube life. Literature is available.

TO REQUEST ADDITIONAL FREE DATA

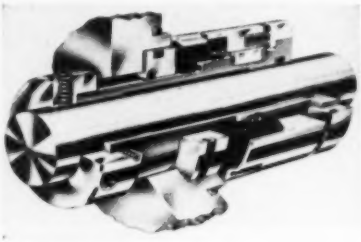
Insert "key" numbers on return post card found on page 115. Our Reader's Service Department will handle your request promptly

Cutting oils keep parts cooler

D-27 Sun Oil Co. reports that new additives have made possible the development of four non-emulsifying cutting oils which keep parts and tools up to 50 degrees cooler. Two of the products, Sunicut 11-S and 209-S, are non-staining, dual purpose oils for heavy duty machining operations. The other two, Sunicut 102-S and 110-S, contain active-type sulfur, and are especially effective for heavy duty machining operations.

Dehumidifier is designed for heavy duty service

D-28 Low initial cost and economy of operation are reported as important advantages of a heavy duty electric dehumidifier developed by the Air Conditioning Div. of Remington Corp. Called the Moisture Magnet, it is a self-contained unit which automatically removes excess moisture from the air. Except for an electric outlet, no installation is necessary. For drainage, it may be placed over a floor drain, a pail may be used to collect the water, or it may be hooked up to a drainage system. Operation is on 208 or 230 v, 50 or 60 c, single or three phase; or 230 v d-c. Typical uses are discussed in a 6-page folder.



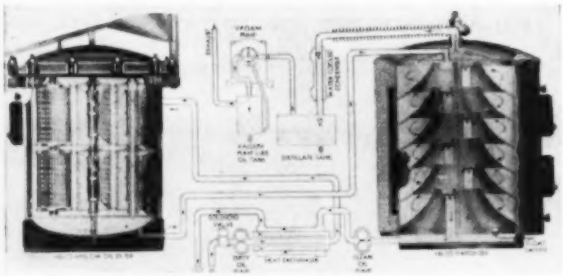
Mechanical seals withstand high pressures

D-29 Crane Packing Co. has developed a heavy-duty mechanical seal to withstand pressures up to 1000 psi. Designated type 8-B shaft seal, it is furnished pre-assembled on a sleeve for ready installation. When used with split case pumps, it is not necessary to lift the upper half of the casing to install

(Continued on page 20)

Oil reclaiming system provides high capacities

D-25 For purification and maintenance of industrial oils such as transformer insulating oils, vacuum pump lubricating and sealing oils, and lubricating oils for diesel and gasoline engines, The Hilliard Corp. has added oil reclaimers with increased capacities to their Hyflow line. The units are said to continuously remove contaminants which impair equipment operating efficiency. Dirty oil, picked up by a pump, passes through a heat exchanger, and then through the filter, which removes all traces of solid matter. A vaporizer, which heats the oil under vacuum, completes the process by removing volatile materials. Units with capacities up to 500 gph are listed in available literature.



WILL THIS

ORGANIC AGENT ELIMINATE BOILER SCALE AND SLUDGE?

It might.

In water conditioning, the supplementary use of organic agents may well assure the difference between long, uninterrupted operation and frequent boiler outages due to scale and sludge formations.

But a word of warning! Not all organics are the same or equally effective.

Take, for example, the case of a large mid-western steel plant which had to acid-clean its 450 psi boilers at 8-12 month intervals.

Due to sharp variations in the raw polluted river water, the hardness and silica content of the lime soda effluent could not be maintained consistently as low as desired. Despite the use of phosphate-tannin treatment, boilers opened up in poor condition.

Betz Engineers studied the problem and recommended changing the type of organic. Results? Since this change, the boilers have not been acid-cleaned or turbined in three years.

What's more, the latest inspection report after 11 months' operation, showed that the only deposit found in the boilers was a handful of sludge.

If *your* plant is plagued by scale and sludge deposits, why not do something about it *now*, by calling in a Betz Engineer. He'll show you factual evidence how Betz *Specialized* Water Conditioning Service can help you solve *your* water problem. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

Write today for a copy of Betz Technical Paper No. 98, "Boiler Scale —Its Formation and Prevention."

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

SOUTHERN'S

COORDINATED COAL SERVICE GIVES VALUE-WISE INDUSTRY MORE THAN COAL—

Dependability . . . This is your assurance when you do business with SOUTHERN—a responsible organization of experienced coal specialists . . . Their extensive resources, complete facilities and practical knowledge of industrial coal problems are efficiently coordinated to give you *the greatest value for your coal dollars.*

SOUTHERN gives you the protective insurance of these essentials to fuel economy and year after year coal satisfaction—

● Combustion engineering collaboration ● Accurate equipment analysis ● Right coal application, specific to your requirements—proved by burning tests ● Outstanding selection of uniform quality coals ● Rigidly controlled preparation—coals washed, precision sized and laboratory tested daily at the mines ● Dependable supply: 16 completely mechanized operations, 10,000,000 tons annual capacity; shipment over nine major railroads and lake transport through Chicago's modern Rail-to-Water Transfer Facility from mines in Ohio, Western Kentucky, Indiana and Illinois.

SKIBO MINE—W. Ky.

VOGUE MINE—W. Ky.

EFFICIENT COAL UTILIZATION

SEND FOR THIS FREE BOOKLET

Written by Joseph Harrington—one of America's foremost combustion engineers and authorities on Coal; its history, chemistry, properties, preparation, efficient utilization and storing.

OLD ABE MINE—W. Ky.

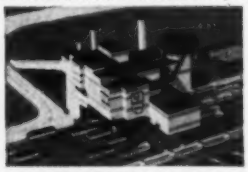
WILMINGTON MINE—N. Ill.

SEMINOLE MINE—Belleville Dist., Ill

SUNLIGHT MINE—S. Ind.

GRAHAM MINE—W. Ky.

KEY MINE—Fulton Co. Ill.



TECUMSEH MINE—S. Ind.

BROKEN ARO MINE—S. Ohio

YOU CAN RELY ON SOUTHERN'S ENGINEERED INDUSTRIAL COALS

Southern Coal Company, Inc.

ONE OF SOUTHERN'S UNIFORM QUALITY COALS IS RIGHT FOR YOUR BURNING EQUIPMENT

KENTUCKY

SKIBO—Shipped from Skibo, Kentucky (Muhlenberg County), on the I. C. Railroad. Modern preparation plant, washing capacity 500 tons per hour. Sizes: 7 x 3" Washed Egg, 1½ x ¾" Washed Chestnut, ¾ x ¼" Washed Domestic Stoker, 1½x¼" Washed Stoker, 1½", 1", ½"x28 Mesh Washed Stoker, Oil treated is desired.

VOGUE—Shipped from Vogue, Kentucky (Muhlenberg County), on the I. C. and L. & N. Railroads. New, completely modern preparation plant. Washing capacity 500 tons per hour. Sizes: 7 x 3" Washed Egg, 1½ x ¾" Washed Chestnut, 1½x¼" Washed Com. Stoker, 1½" or 1" x 28 Mesh Washed Stoker, Auto-Flame Washed and Oil Treated Domestic Stoker. Oil treatment if desired on all sizes.

OLD ABE—Shipped from Bixby, Kentucky (Ohio County), on the I. C. Railroad. New, modern preparation plant, washing capacity 800 tons per hour. Sizes: 7" Lump, 7 x 3" Washed Egg, 3 x 1½" or 2" Washed Nut, 1½ x ¾" Washed Chestnut, 1½x¼" Washed Stoker, ¾x¼" Washed Domestic Stoker, 1½", 1" or ¾"x28 Mesh Washed Stoker, ¼" Washed Carbon. Oil treatment if desired.

GRAHAM—Shipped from Graham, Kentucky (Muhlenberg County), on the I. C. Railroad. Thoroughly washed and carefully prepared. Sizes: 7" Lump, 7x3" Washed Egg, 3x2" Washed Junior Egg, 3x1¼" Washed Nut, 1½" Washed Stoker, 2" or 1¼"x0 Screenings.

POWERHOUSE — Specially prepared Crushed and Washed Screenings from two large mines in Western Kentucky. Shipped from Vogue and Skibo, Kentucky (Muhlenberg County), on the I. C. and L. & N. Railroads. An exceptional coal for Industry.

ILLINOIS

WILMINGTON—Shipped from Mullins, Illinois (Wilmington District), on the Santa Fe and C. M. & O. Railroads. Exceptionally low ash coal from North-Illinois—prepared in a plant with all of the necessary facilities for careful washing and sizing—washing capacity, 350 tons per hour. Sizes: 5x3" Washed Egg, 2x1½", 1½x1", 1½x¼", 1x¼", ¼"x0. Screenings 2", 1½", 1". Stoker and Screening sizes heat dried. Oil treatment if desired.

KEY—Shipped from Astoria, Illinois (Fulton County), on the C. B. & Q. Railroad. New McNally-Pittsburg washer and preparation plant. Washed screenings are heat dried. Sizes: 7x3" and 7x4" Egg, 4x2" Egg, 2", 1½", 1¼", 1", ¾"x28 Mesh Washed Screenings.

SEMINOLE—Shipped from Seminole, Illinois (St. Clair County), on the I. C. Railroad. Producing high quality No. 6 Seam Coal. Precision preparation in a modern plant—washing capacity 350 tons per hour. Sizes: 7x3" Washed Egg, 4 x 2" Washed Nut, ¾ x ¼" Washed Stoker, 1½", 1¼" or ⅞"x28 Mesh Washed Screenings. Stoker and Screening sizes heat dried.

INDIANA

TECUMSEH—Fifth Vein Washed Coal shipped from Tecumseh, Indiana, on the New York Central Railroad. A large producing mine—washing capacity 850 tons per hour, in a precision-built McNally-Pittsburg plant. Sizes: 6 x 4", 4x2", 4x1½", 2x1½", 1½x1", 1½x⅜", 1x⅜", 2"x10 Mesh, 1½"x10 Mesh, 1"x10 Mesh, ⅜"x10 Mesh. Stoker and Screening sizes heat dried. Oil treatment if desired.

SUNLIGHT—Shipped from Boonville and Tecumseh, Indiana, on the Southern and New York Central Railroads. Producing excellent quality Fifth Vein Coal in a plant with latest facilities for thorough washing and precision sizing—washing capacity 500 tons per hour. Sizes: 6 x 4", 4 x 2", 4 x 1½", 2 x 1½", 1½x1", 1½x⅜", 1x⅜", 2"x10 Mesh, 1½"x10 Mesh, 1"x10 Mesh, ⅜"x10 Mesh. Stoker and Screening sizes heat dried.

OHIO

BROKEN ARO—Shipped from Wellston, Ohio, on the B. & O. Railroad. A new large producing mine with a rated capacity of half a million tons annually. Precision preparation in a McNally-Pittsburg processing plant. All sizes thoroughly washed and graded with most modern equipment. Sizes: 6x3" Washed Egg, 3x1¼" Washed Nut, 1¼x⅜" Washed Stoker, 2", 1" or ¾"x10 Mesh Washed Screenings.

ALABAMA

MARIGOLD—Shipped from Marigold, Alabama, on the Alabama Central Railroad, from the famous Black Creek Seam. Modern washer and preparation plant. Sizes: 6" Lump, 6x3" Egg, 3x1½" Nut, 1 x ¼" Domestic Stoker (oil treated), 1"x28 Mesh Stoker, 1½"x28 Mesh Stoker. Oil Treatment if desired.

YOU CAN RELY ON SOUTHERN'S ENGINEERED INDUSTRIAL COALS

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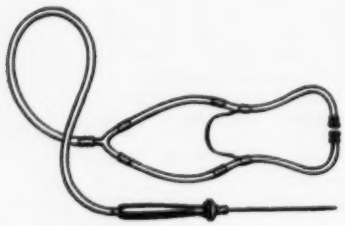
SINCLAIR COAL COMPANY, KANSAS CITY 6, MO., WESTERN REPRESENTATIVE

MEMBER BITUMINOUS COAL RESEARCH, INC.

new equipment

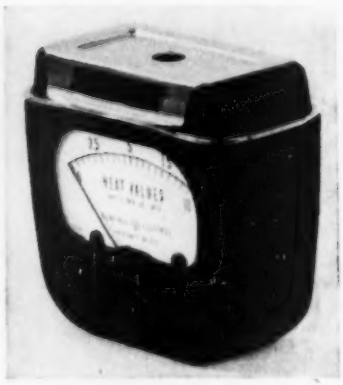
(Continued from page 16)

the seal. Compact design adapts it for use in conventional pump stuffing boxes. A rotating sealing washer and a floating stationary seat are used. Balance is accomplished by lowering washer face to a point where stuffing box pressure is not exerted against sealing area.



Instrument traces sound to its source

D-30 Based on the principal of a doctor's stethoscope, the MS-1 Multiscope traces trouble sounds, such as sounds caused by leaks, knocks in circulating systems, foreign noises in circulating pumps, and many other plumbing and heating system defects, to their source by locating the point of greatest intensity. According to the manufacturer, Armstrong Machine Works, an accurate diagnosis can often be made if the source and type of noise is known, thus eliminating time-consuming research and needless dismantling.



Infrared meter for radiation work

D-31 Radiant energy intensities up to 10 w per sq in. can be measured by an infra-red meter developed by General Electric Company's Meter and Instrument Dept. Designated type DW-69, the unit is especially suited for determining intensity of high range, radiant energy sources, and for studies of infra-red radiation effects concerning absorption and transmission properties of materials. It is said to be inexpensive and, since no separate thermopile or other accessory equipment is needed, it is easy to operate.

Oil burner control provides added protection

D-32 Protection for oil-fired heating equipment, as well as automatic control of operation, is afforded by the C-502 oil burner controller developed by Iron Fireman Manufacturing Co. Mounted in the stack, it automatically starts the burner in response to thermostat demands and keeps it running as long as heat is needed. In addition, a built-in safety switch gives protection against ignition or flame failure. If power supply lapses, the unit automatically recycles and begins normal burner operation as soon as power is restored.

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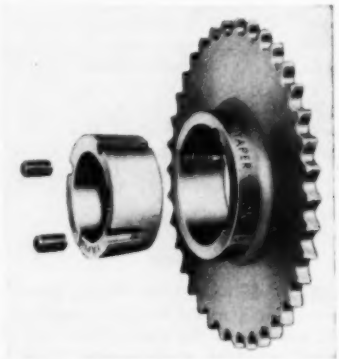
Insert "key" numbers on return post card found on page 115. Our Reader's Service Department will handle your request promptly

Dynamometer simplifies testing of electric motors

D-33 George L. Nankervis Co. has developed a dynamometer for testing a-c and d-c electric motors. Known as Tru-Tork model 52 Custom, it features a self-regulating absorption unit and a torque scale which reads in foot-pounds and horsepower. The unit provides constant torque loading regardless of motor speed variations, thus simulating field conditions. Switchgear is provided for selecting either single or three phase power for the motor under test. Meters indicate a-c volts, a-c amperes, a-c watts and speed of the motor while in operation. The unit is rated 3 hp at 1800 rpm, and has a speed range extending to 4000 rpm.

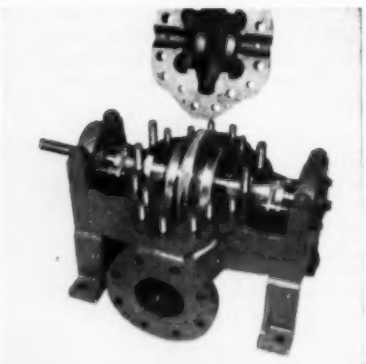
Magnetic relay is self-shielded

D-34 Features of a magnetic contact type relay, developed by Weston Electrical Instrument Corp., include sealing against moisture, a self-shielded core magnet mechanism, and a built-in solenoid release device. A variety of ranges are available with double or single magnetic contacts to make contact on either increasing or decreasing values. Sensitivities as high as 2-0-2 microamperes are available, and both a-c and d-c voltage ranges can be supplied self-contained up to 500 v. The unit, known as model 723 Sensitrol, is equipped with a sealed zero corrector, solder terminal connections, and a removable bezel.



Bushed sprocket permits immediate delivery

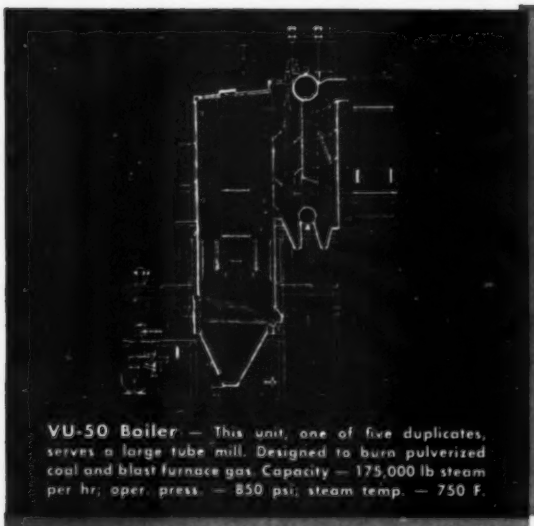
D-35 To provide off-the-shelf availability, Dodge Manufacturing Corp. has incorporated the Taper-Lock principle in the design of sprockets. Costly and time consuming reboring to fit shafts is eliminated, and the shafts do not have to be turned and ground to obtain a tight fit. The units occupy no more space than standard sprockets, since they have no flange or protruding parts. B-type steel sprockets are available with 40 to 100 pitch. How the units are used is explained in an available bulletin.



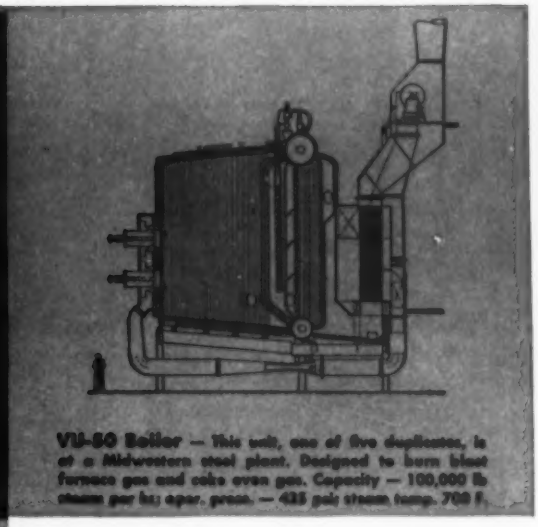
Centrifugal pump features short bearing spans

D-36 Compactness is an important feature of the Fig. 3405, single stage, double suction centrifugal pump developed by Goulds Pumps, Inc. Bearing spans have been kept to the shortest practical distance, resulting in important savings in length. Casings are horizontally split. Design of the shaft sleeves makes it easy to change direction of rotation in the field without additional parts. A double-suction type impeller is said to provide hydraulic balance. Either packing type stuffing boxes or

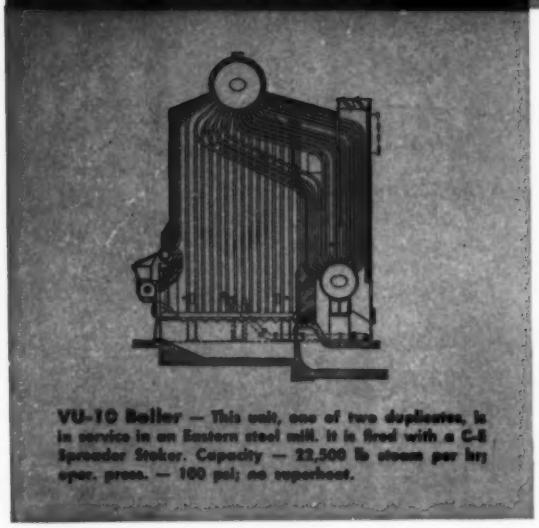
(Continued on page 24)



VU-50 Boiler — This unit, one of five duplicates, serves a large tube mill. Designed to burn pulverized coal and blast furnace gas. Capacity — 175,000 lb steam per hr; oper. press. — 850 psi; steam temp. — 750 F.



VU-80 Boiler — This unit, one of five duplicates, is at a Midwestern steel plant. Designed to burn blast furnace gas and coke oven gas. Capacity — 100,000 lb steam per hr; oper. press. — 435 psi; steam temp. 700 F.



VU-10 Boiler — This unit, one of two duplicates, is in service in an Eastern steel mill. It is fired with a C-E Spreader Stoker. Capacity — 22,500 lb steam per hr; oper. press. — 100 psi; no superheat.

Leading Metal Producers using VU units in one or more plants

Aluminum Company of Canada, Ltd.
Anaconda Wire & Cable Co.
Bethlehem Steel Co.
Bridgeport Brass Co.
Chase Brass & Copper Co., Inc.
Cia. Siderurgica Nacional
Great Lakes Steel Corp.
Jones & Laughlin Steel Corp.
National Tube Co.
Phelps Dodge Corp.
Pittsburgh Steel Co.
Republic Steel Corp.
Revere Copper and Brass Inc.
Sloss-Sheffield Steel & Iron Co.

Industry Leaders select VU

One significant fact about the C-E Vertical-Unit Boiler is its wide acceptance by leading companies in practically every industry. This is so important to *all* companies because buying decisions of the larger manufacturers are often a practical guide for everyone right down the line.

Primary metal producers are an outstanding example. The reliability of their steam generating equipment is of utmost importance, since steam failure may cause extensive damage to costly equipment. It is especially significant then that many of the world's largest metal producers, each guided by its own investigations and conclusions, reached a common decision as to the merits of Vertical-Unit Boilers.

These companies have *proved* their satisfaction with VU Units by buying them again and again. One company purchased three in 1940 . . . three more in 1946 . . . five in 1949 . . . and two in 1951 — *thirteen units in eleven years.* In fact, the fourteen companies listed here have bought a total of 69 Vertical-Unit Boilers.

You can profit from the example of the primary metal industry — or from any industry where steam is exceptionally important. You will find — as so many others have found — that the C-E Vertical-Unit Boiler means lower steam costs through advanced design . . . sound construction . . . proved reliability. If you need steam — from 10,000 to 350,000 pounds per hour — take a tip from the leaders — investigate VU.

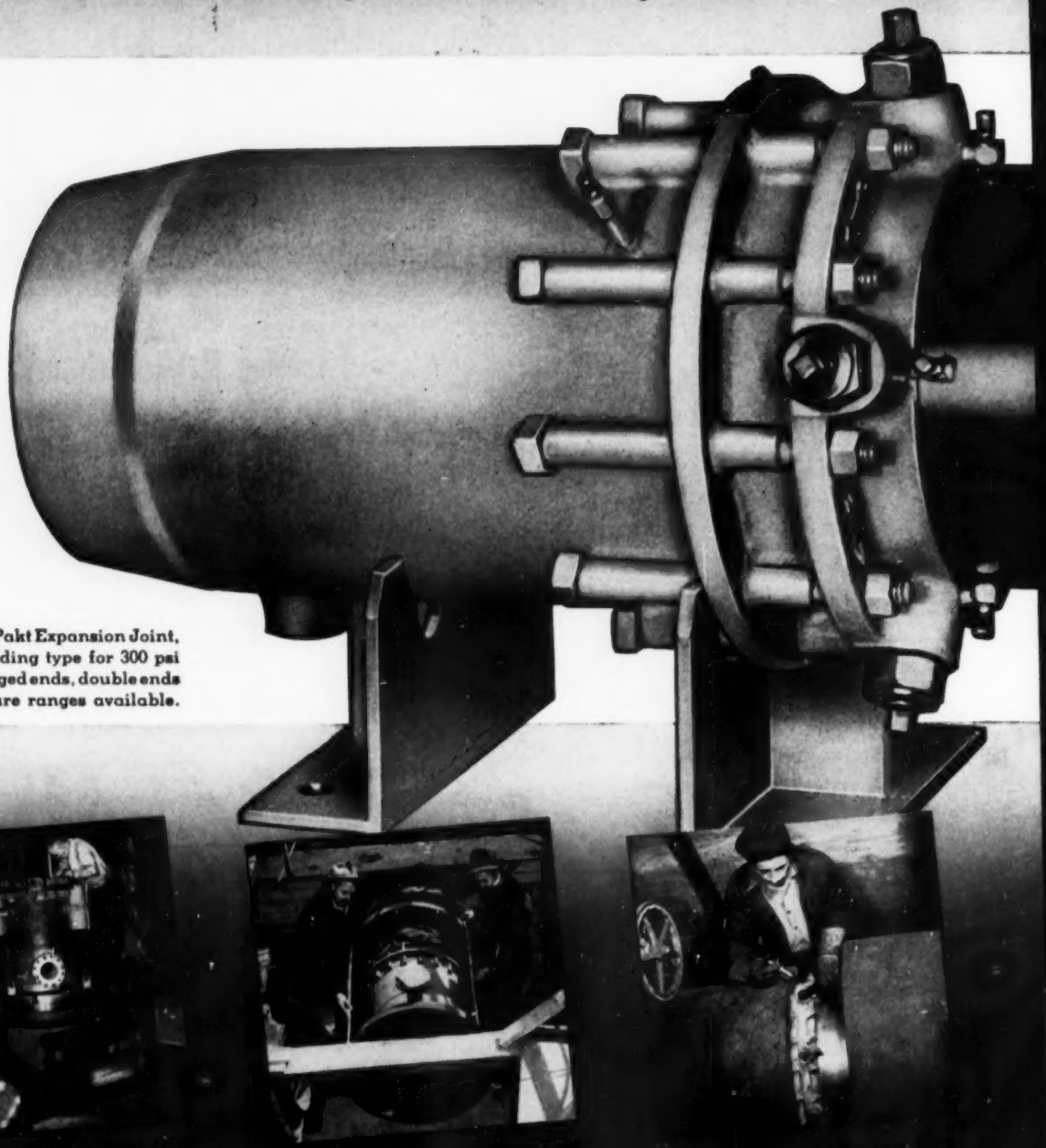
COMBUSTION ENGINEERING—SUPERHEATER, INC.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

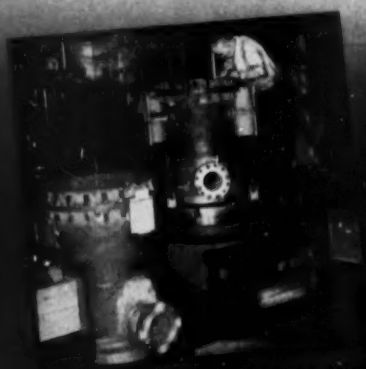
B-625A

• ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

PHILADELPHIA ELECTRIC
GUN-PAKT EXPANSION JOINTS for

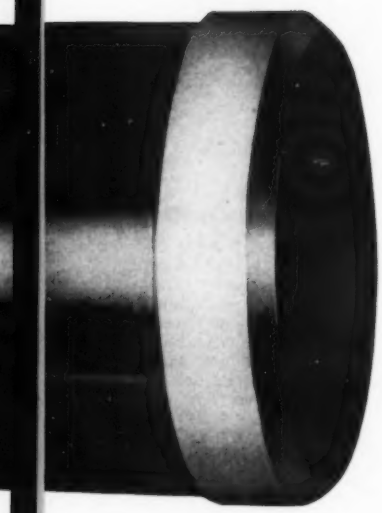


Yarway Gun-Pakt Expansion Joint, single end welding type for 300 psi pressure. Flanged ends, double ends and all pressure ranges available.



YARWAY

relies on 24" UNDERGROUND STEAM LINE

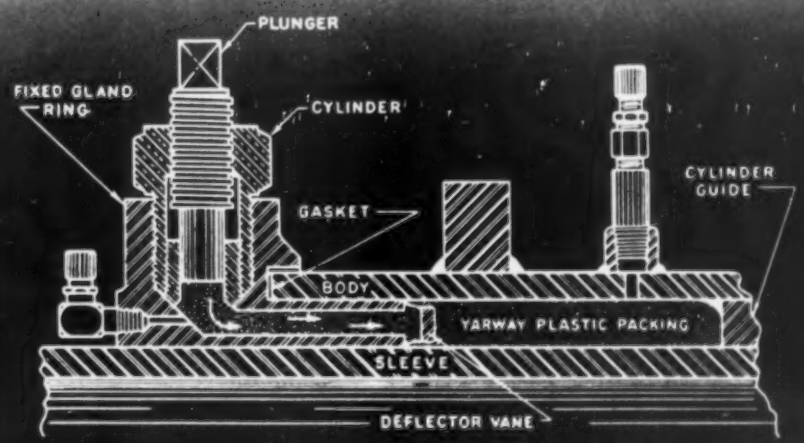


Philadelphia Electric Co. is one of many utilities, institutions and industrial plants who rely on Yarway Gun-Pakt Expansion Joints for steam distribution lines. As an example, twenty-four large 24" Gun-Pakt Joints are helping maintain PE's reputation for reliability, on their new 24" steam distribution line. Gun-Pakt Joints frequently are selected because of the following features.

- **HIGH FACTOR OF SAFETY.** Gun-Pakt Joints are rugged joints—strong and dependable.
- **LOW MAINTENANCE.** No need for shutdowns, because Gun-Pakt Joints are *serviced under full steam pressure.*
- **FEWER JOINTS NEEDED.** Each sliding sleeve may have a 4", 8", or 12" traverse—maximum expansion 24" for a double-end joint. Fewer needed in given length of line.

For the full story on these and other Gun-Pakt Expansion Joint features (like service outlets right on the joint) write for Yarway Catalog EJ-1912.

YARNALL-WARING COMPANY
109 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities



GUN-PAKT EXPANSION JOINT

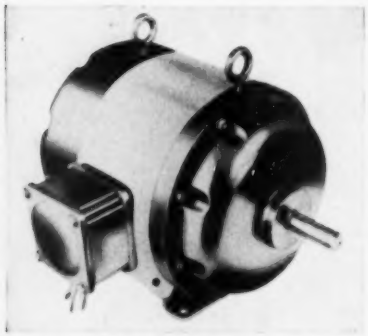
new equipment

(Continued from page 20)

mechanical seals can be furnished. Capacities from 200 to 6400 gpm, with heads to 260 ft, are listed in a bulletin.

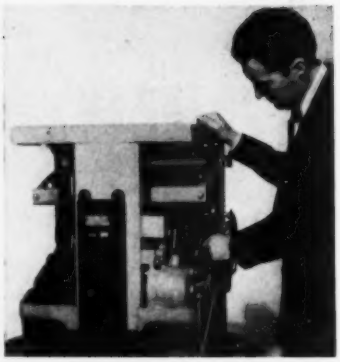
Filters provide for cleaning without removal from line

D-37 Small pipe line filters, designed for compressed air or gas with maximum pressure of 40 psi, have been announced by Dollinger Corp. One-bolt accessibility is said to provide quick inspection and cleaning. Two sizes are available with either absorption pad media or radial fin inserts. The AA series, with absorption pad media, remove all traces of oil and water vapor, while the CH series, with radial fin inserts, are designed to rid lines of dirt and pipe scale. Construction is described in an available bulletin.



Motors are designed for chemical plants

D-38 Special insulation treatments are used on chemical plant motors by the Industrial Motor Div. of Robbins & Myers, Inc., to permit applications involving acids, alkalies, dyeing and bleaching, canning and packing, and peroxide. Special attention also has been given to protection of metal parts against the ravages of corrosion. The motors, with ratings from 1 to 40 hp, are available with either totally-enclosed or explosion-proof construction.

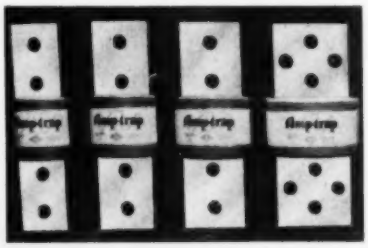


Stored energy closes air circuit breakers

D-39 Air circuit breakers with a stored-energy closing mechanism are being used in low-voltage drawout switchgear developed by General Electric Co. The switchgear has standardized compartment construction, and is available with ratings of 600 v a-c and below.

TO REQUEST ADDITIONAL FREE DATA

Insert "key" numbers on return post card found on page 115. Our Reader's Service Department will handle your request promptly

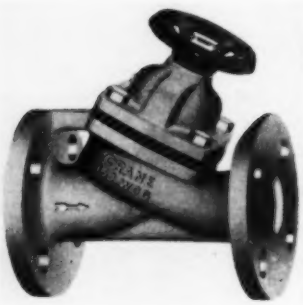


High IC fuse protects low voltage networks

D-40 Designed for entrance switch service, underground network conductors, and panelboards, the form 208 Amp-trap interrupting capacity fuse is said to prevent a build-up of heavy fault currents in 120 and 208 v a-c networks. According to the manufacturer, the Chase-Shawmut Co., a short circuit current is stopped before it can reach the crest of the first ¼ cycle, even though available crest current value may be as high as 330,000 amp. Low power loss is listed as an additional advantage. Ratings are from 200 to 5000 amp.

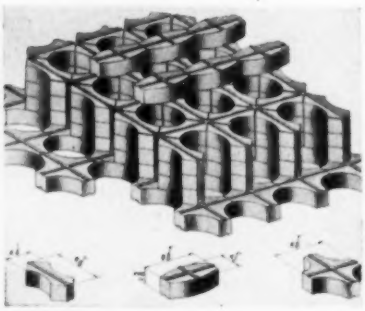
Unit automatically lubricates conveyer trolley wheels

D-41 Simplified lubrication of conveyer trolley wheels is provided by a lubricator designed by Alemite Div. of Stewart-Warner Corp. It delivers a preset amount of either oil or grease to each trolley wheel simply by the flick of a switch. In operation, a coupler clamps onto the lubricant fitting and delivers the required amount of lubricant as it passes the unit. The coupling then disengages and is ready for the next wheel. The unit can be located at any convenient spot along the conveyer track, providing it is within reach of the plant air line and a 115 v, 60 c electrical outlet.



Valves feature separate diaphragm and disc construction

D-42 Crane Co. has reported the use of several new body, diaphragm, and lining materials for packless diaphragm valves. Cast iron, brass, aluminum, or 18-8 Mo bodies and disc holders are available, with diaphragms and disc inserts of Neoprene, Buna-N, and natural hard rubber linings. Special designs for vacuum, oxygen, and acetylene also are available. Outstanding feature is the separate diaphragm and disc construction. Since the diaphragm is not used for seating, it is not subjected to cutting, crushing, or abrasion. Closure of the independent disc will prevent escape of line fluids even if the diaphragm should fail.



Checker system reduces draft loss

D-43 To keep open hearth furnaces sharper longer, Geo. P. Reintjes Co. has developed a circular well formed principally with but one shape of refractory. Referring to the illustration, four pieces of tile are used to form each well. A second tile is located where horizontal lancing is desired, and a cross shape is used as a header course every fourth to fifth row. Tongue and groove construction centers the tiles and ties them together. This type of construction is particularly adaptable to two pass checkers, where pressure drop creates excessive strain on the fans.

(Continued on page 32)

COPPUS "BLUE RIBBON" VENTILATORS

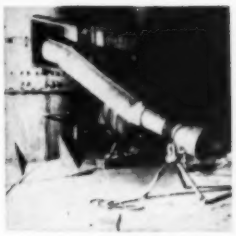
identified by the blue band

FOR WORKERS'

- *Safety*
- *Health*
- *Comfort*
- *Efficiency*

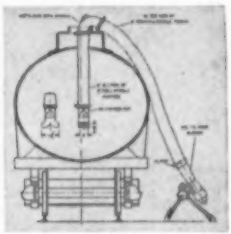
VANO® Design "A" VENTILATOR

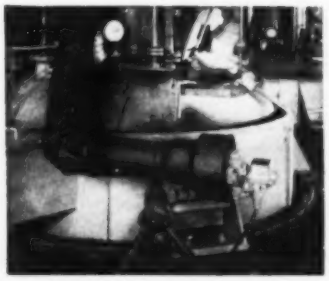
Vano Design "A" cooling interior of furnace, supplying fresh air through 10 feet of "Ventube" to provide safety and comfort during repair work.



Vano Design "A" delivering fresh air to cable manhole, expelling sewer gas, making entrance safe in a few minutes.

Vano Design "A" Ventilator plus a few accessories feeds large air volume into tank car, driving out fumes, stagnant or hot air for workers' safety and comfort.





Vano Design "A" supplying fresh air in Reactor Room of Synthetic Rubber Plant.

Vano Design "A" Ventilator supplying fresh air to men working in wing compartments, fuselages, etc.

Powered by a ½ hp motor, and equipped with the exclusive Coppus axial-flow propeller-type fan, this general-purpose blower delivers 1500 CFM of fresh air. It supplies ventilation for tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments and fuselages, and other confined places. Weighs only 103 lbs. Uses 8"-diameter flexible canvas tubing ("Ventube").

VANO DESIGN "C"

VENTILATOR-EXHAUSTER

Vano Design "C" equipped with 8" discharge tubing removing welding fumes.

Vano Design "C" equipped with two suction lines removing welding fumes for operators' safety.

For withdrawing welding fumes from confined places or directly from the welding rod ...or for expelling fumes or hot air from enclosed vessels. You can get it with 8" suction inlet for 8" non-collapsible tubing ...or with multiple inlet nozzles for 5", 4" or 3" suction hose. The discharge outlet takes 8" "Ventube". Powered by a ½ hp motor, it weighs only 85 lbs.

COPPUS ENGINEERING CORP., 184 PARK AVENUE, WORCESTER 2, MASS.
Please send information on the Blowers that clear the air for Action.

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuslages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

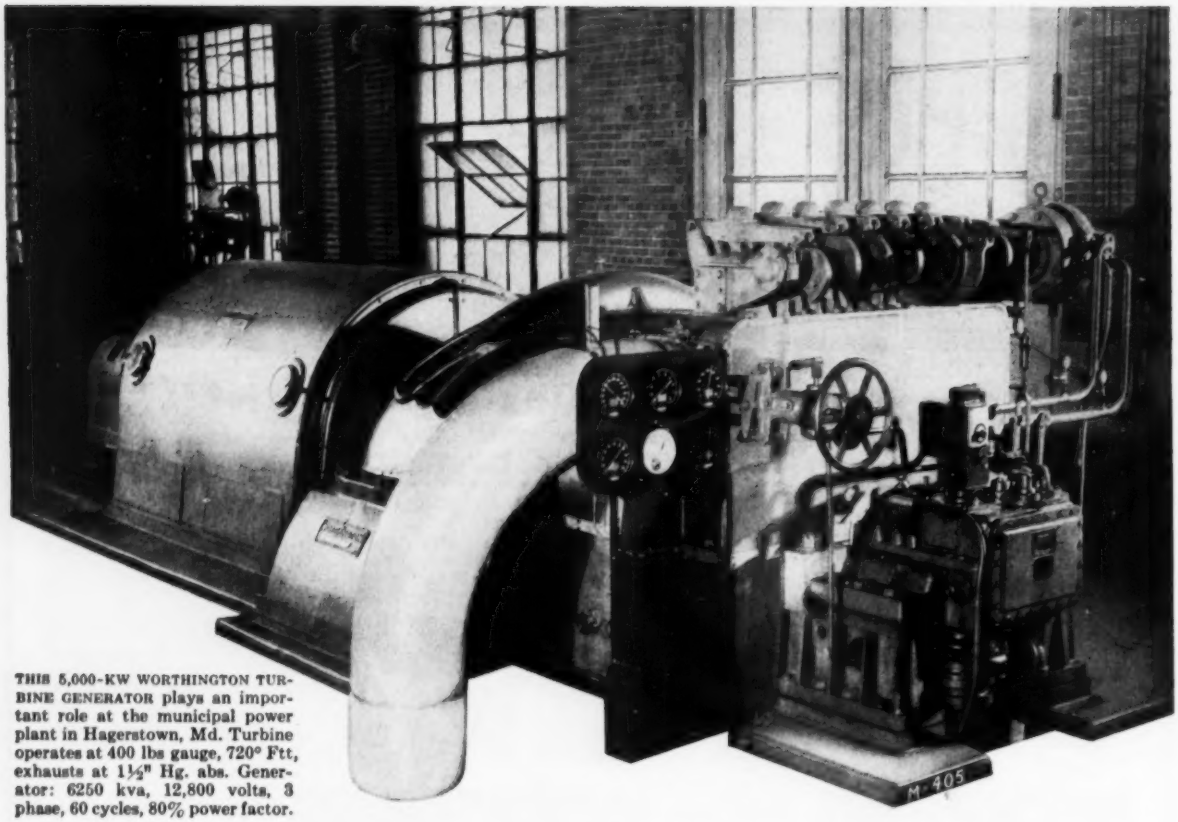
COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME .....
COMPANY .....
ADDRESS .....
CITY .....

(Write here any special ventilating problem you may have.)

COPPUS "BLUE RIBBON" PRODUCTS—*Designed for Your Industry, Engineered for You*



THIS 5,000-KW WORTHINGTON TURBINE GENERATOR plays an important role at the municipal power plant in Hagerstown, Md. Turbine operates at 400 lbs gauge, 720° Ftt, exhausts at 1½" Hg. abs. Generator: 6250 kva, 12,800 volts, 3 phase, 60 cycles, 80% power factor.

WORTHINGTON turbine generator at City of Hagerstown, Md. completes second year of continuous operation

A little over two years ago Hagerstown, Maryland, took one of the biggest steps in its $1,500,000 post-war power-plant expansion program. They installed and began operating a 5,000-kw Worthington turbine generator unit.

Fulfilling the reputation for reliable performance held by all members of Worthington's team in steam, this power supply has run continuously since installation.

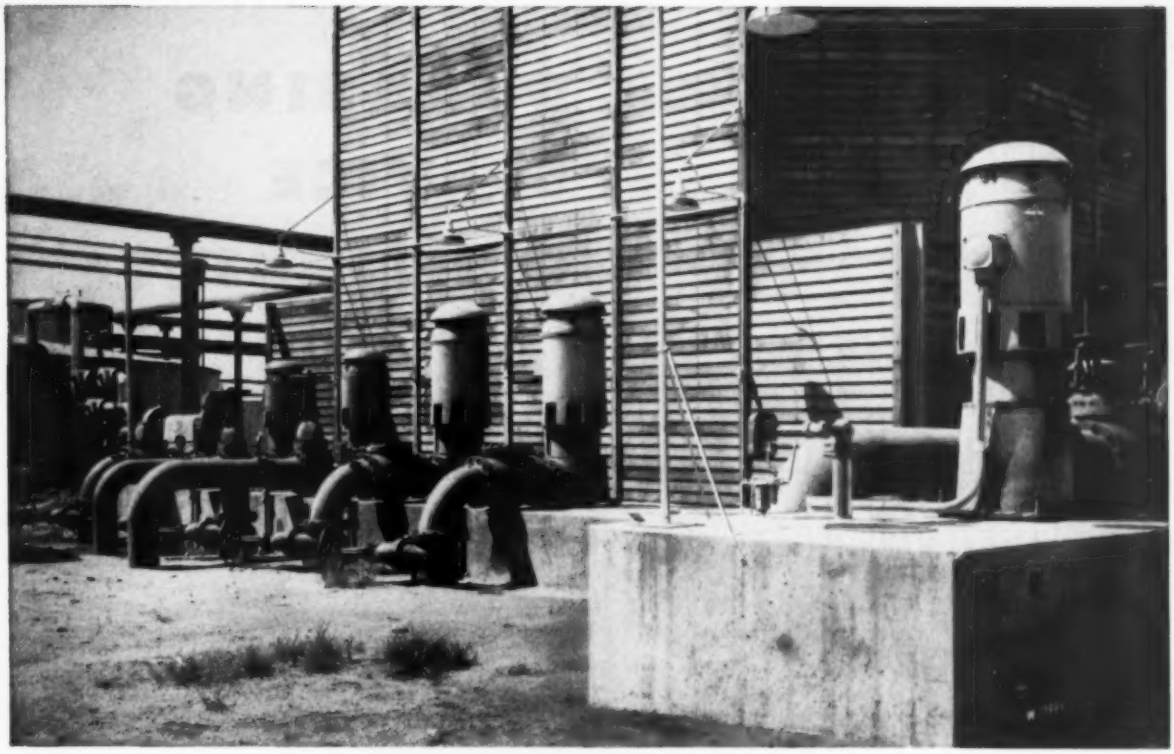
Hagerstown is just another of the many Worthington users that are reaping the rewards of the experience and specialized engineering that go into the manufacture of these long-life, ever-dependable turbine generators.

Keynote of Worthington's service reliability is the advantage you get because Worthington turbine generators are designed, assembled and tested for combined operation—as a complete unit—*before* shipment. Built in sizes up to 10,000 kw, the performance records of these machines are added proof that *there's more worth in Worthington*. For detailed information, consult your nearest Worthington representative or write to Worthington Corporation, Steam Turbine Division, Wellsville, New York. T.1.11

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbine Generators



WORTHINGTON VERTICAL TURBINE PUMP installation at The Derby Oil Company refinery in Wichita, Kansas. The pump on the extreme left is driven by a Worthington steam turbine.

Vertical turbine pumps— the logical choice for cooling tower service

During installation of a new cat cracker, The Derby Oil Company revised their entire cooling system at their Wichita, Kansas, refinery and purchased a new three section cooling tower. As part of this system, eight Worthington vertical turbine pumps were installed. Here are some of the inherent characteristics of vertical turbine pumps that make these units the logical choice for this application:

1. Drive unit is remote and separate from the pumping element.

2. No need for priming or expensive dry pits because pump always operates submerged.

3. No suction problems.

Worthington gives you the newest, best-engineered vertical turbine pump available today. Find out more about these modern Worthington units. Contact your nearest Worthington district office, or write to Worthington Corporation, Vertical Turbine Pump Division, at Succasunna, New Jersey, or Denver, Colorado.

D.2.8

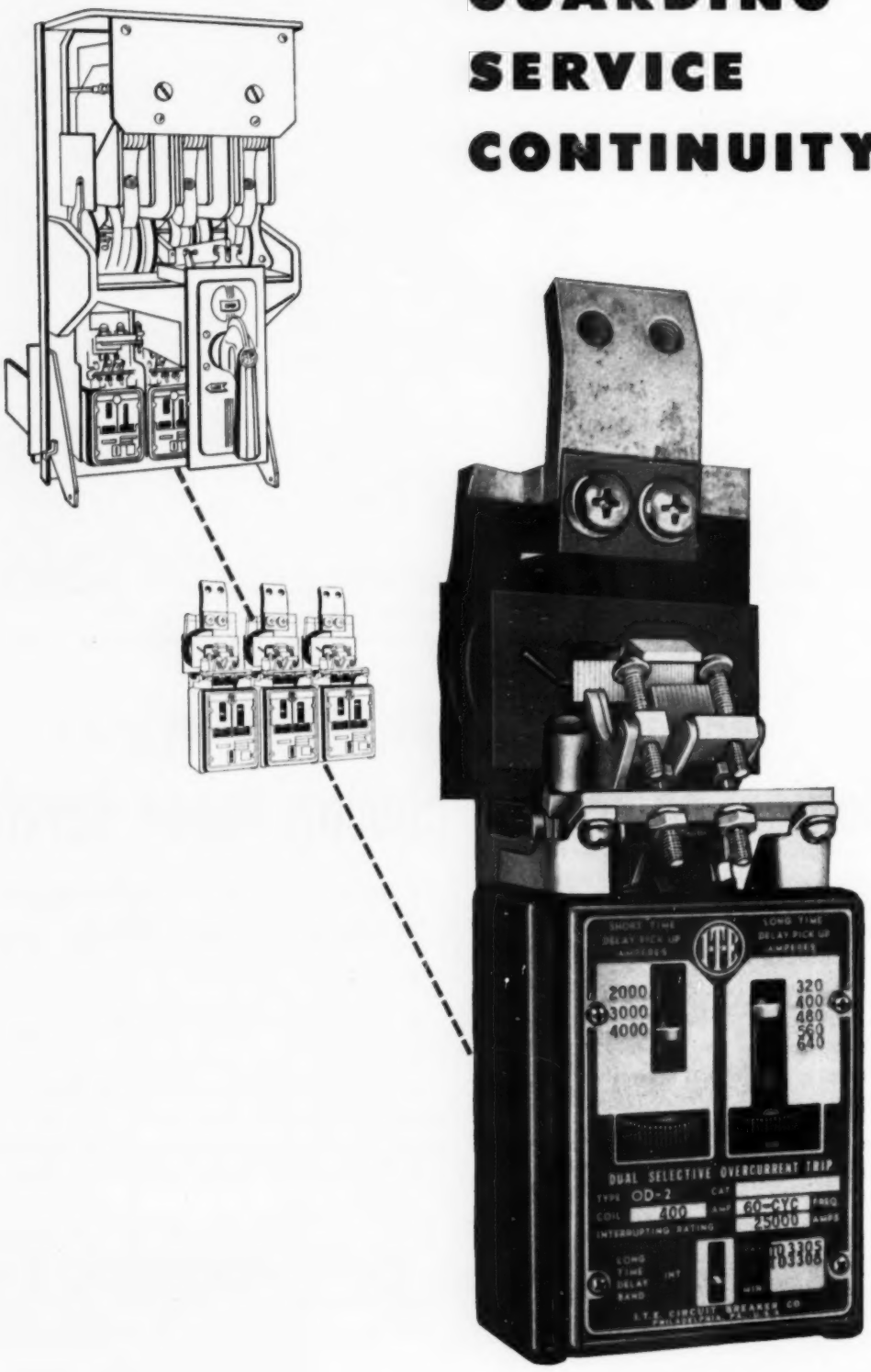
The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON

Vertical Turbine Pumps

CONSERVE GROUND WATER—IT IS A VALUABLE RESOURCE AND IS NOT UNLIMITED

GUARDING SERVICE CONTINUITY:



integral selective trip protection in I-T-E Circuit Breakers

Include this direct-acting device in your switchboard planning

Selective tripping allows the most effective use of large air circuit breakers when high reliability of service is essential. With it, several circuit breakers may be used in series; yet on overcurrent or fault only the affected circuit is interrupted. The breaker nearest to the trouble trips. The breakers nearer to the power source remain closed.

The I-T-E Type OD-2 Selective Overcurrent Trip Device is a means of accomplishing this—without current transformers, relays, or additional switchboard panels.

The OD-2 device offers accurate long-time delay (in seconds and minutes) to provide inverse time current protection on overloads. It also offers accurate short-time delay (in cycles) to provide selectivity between breakers when a short circuit occurs. The trip device is sturdy, compact, shock resistant. Time delay elements are sealed and require no maintenance.

I-T-E Circuit Breakers with these devices should be considered for every new low-voltage switchgear application. In recent years, installations using I-T-E breakers with selective trip devices have been made in central stations, in manufacturing plants, and in processing industries. They have saved in initial investment, in reduced breaker maintenance, and have provided greater reliability to the systems.

***Bulletin 5301* gives full details. Send for a copy.**

I-T-E Type OD-2 Direct-Acting Dual Selective Overcurrent Trip Devices are compact *integral* parts of the circuit breaker. Adjustments can be made for long-time current pickup, long-time delay, short-time current pickup, and short-time delay.

LOW-VOLTAGE SWITCHGEAR

I-T-E CIRCUIT BREAKER COMPANY • 19th AND HAMILTON STS., PHILADELPHIA 30, PA.

Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto

The New "RILEY 50" Pulverizer

Pulverizing elements of the New Riley "50" Pulverizer are faced with tungsten carbide, assuring years of continuous service, low maintenance and sustained fineness without adjustments. The crusher-dryer section evaporates surface moisture so that moisture content of coal does not affect capacity. Foreign materials are also rejected in this section and coal is crushed to fine granular state, without damage to pulverizer.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Charlotte · Atlanta · New Orleans · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS

Spontaneously Accepted by Engineers

Because of These Outstanding Features

1 No capacity reduction with increase in moisture.

2 Tramp iron, iron pyrites and other foreign materials in coal rejected.

3 Pulverizing elements faced with tungsten carbide.

4 Fineness sustained over years of operation.

5 Long periods of operation without necessity of shutdowns.

6 Unusually high capacity per unit of space.

7 Minimum foundation requirements.

8 Ability to carry low loads.

9 Flexibility-wide load range.

10 Operates without coal, with no noise and without wear or damage to parts.

11 Low maintenance and power.

12 No explosion hazard, travel of coal through pulverizer faster than flame propagation.

13 Quiet vibrationless operation.

14 Ease of lighting and regulation.

15 High primary air temperatures.

16 Thoroughly dependable.

17 Negligible cost of lubrication.

18 All moving parts on a single horizontal shaft with bearings outside of housing. No worms or gears.

19 Primary air fan integral with pulverizer—separate fan and motor not required.

All of these people have ordered Riley "50" Pulverizers within the past two years

PUBLIC UTILITIES

Detroit Edison Co.
Iowa-Illinois Gas & Electric Co.
Monongahela Power Co.
Utah Power & Light Co.
Hartford Electric Light Co.
Public Service Co. of Colorado
Iowa Electric Light & Power Co.
Northern States Power Co.
The Potomac Edison Co.
Superior Water, Light & Power Co.
Western Colorado Power Co.
South Carolina Public Service Authority
Corn Belt Power Cooperative
Central Ohio Light & Power Co.

MUNICIPAL PLANTS

City of Richmond, Indiana
City of Holyoke, Mass.
City of Rochester, Minn.
City of Owensboro, Ky.
City of Austin, Minn.

INDUSTRIAL COMPANIES

Carbide & Carbon Chemical Co.
Goodyear Tire & Rubber Co.
Western Electric Co.
General Electric Co.
Hooker Electrochemical Co.
North American Aviation
The Ohio Oil Co.
National Supply Co.
Continental Can Co.
Monsanto Chemical Co.
St. Croix Paper Co.
Celanese Corp. of America
Owens-Corning Fiberglas Co.
Columbia-Southern Chemical Corp.
Lawless Bros. Paper Co.
U. S. Finishing Co.
Bell Aircraft Co.
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U. S. Steel Company
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Great Lakes Naval Training Station
Boston Navy Yard
Ruberoid Co.
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United Engineers & Constructors
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Bechtel Corporation
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Black & Veatch
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Douglas M. McBean
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Burns & McDonald
Kenneth R. Warrington
J. V. Edeskuty
Robert S. Curl & Associates
Interboro Company
Lockwood Greene Engineering, Inc.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

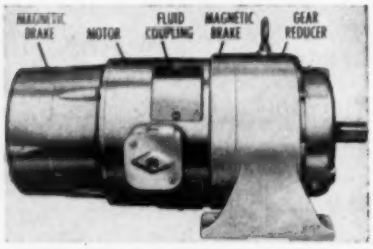
COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

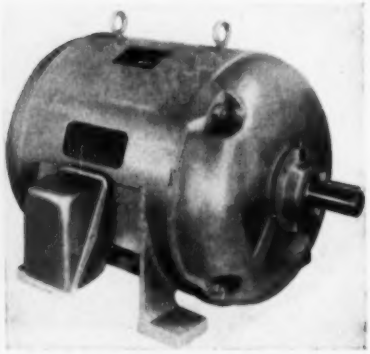
new equipment

(Continued from page 24)



Drive provides smooth deceleration

D-44 To provide fluid-cushion stops and starts, with the added advantage of a holding brake, Reuland Electric Co. has developed a fluid-shaft drive known as the Motoreducer. It consists of a magnetic brake, a motor with internal fluid coupling, a second brake, and a gear reducer. A typical application is for crane travel drives, in which pendulum motion of the load is eliminated through smooth acceleration and deceleration, yet stationary holding action at any point is provided. Other applications are described in an available data sheet.

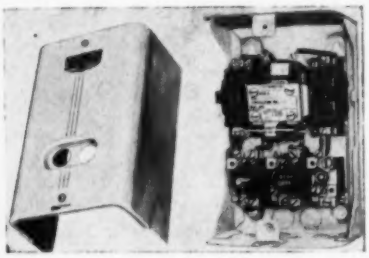


Motors incorporate improved design for longer life

D-45 Modernization of electric motor frames in the higher horsepower ratings of the T-type design has been announced by Electro Dynamic Div. of General Dynamics Corp. The higher ratings, from 60 to 250 hp, offer the advantages of rolled steel frames and cast iron end bells, assuring permanent alignment. Bearing caps at the shaft ends are said to lead to longer bearing life. Units are available in drip-proof construction.

Controller has motor-driven index

D-46 Minneapolis-Honeywell Regulator Co., Industrial Div., has developed a motor-driven index controller said to be especially adapted for cascade control systems and for program control. It is extremely flexible as a program controller when equipped with proper accessories, and can be used for a cascade control system when the primary instrument is equipped with electrical contacts, thus making it valuable for remotely positioning a set point where air or pneumatic control is not available. This type of controller is particularly useful where programs must be varied from batch to batch.



Starter features simplified construction

D-47 Simplified construction, used by Cutler-Hammer, Inc. in the design of an NEMA size 0 starter, is said to provide easier installation and longer life. The unit consists of 5 independent parts: 2 contact blocks; a magnet coil; an armature; and a 3-coil overload relay. A wrap-around cover pulls off, fully exposing the front and both sides.

TO REQUEST ADDITIONAL FREE DATA
Insert "key" numbers on return post card found on page 115. Our Reader's Service Department will handle your request promptly

Trolley system carries high amperage loads

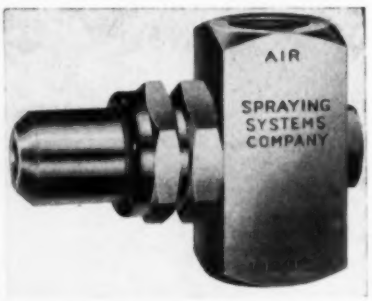
D-48 Universal-Standard, Inc. has developed a trolley system which is said to be capable of carrying loads from 50 to 2000 amp. Known as the U-S Safety Trolley System, it is applicable wherever current collectors are used, such as for traveling cranes, ore bridges, ingot buggies, mine and power applications, and portable electric tools. Its construction, which is said to feature an inexpensive and efficient collector, is described in a 4-page folder.

Electronic motor drive incorporates simplified design

D-49 General Electric Company's Control Dept. has developed a simplified Thy-mo-trol packaged electronic adjustable-speed drive. The system, which offers stepless, pre-set speed control, and close speed regulation, consists of an anode transformer, electronic control panel, control station, and d-c shunt-wound motor. Speed ranges are 5:1 and 20:1 in reversing or non-reversing forms. It operates on 220 or 440 v. single-phase, 50 or 60 c, and is available for ¾ to 3 hp drives.

Centrifugal pump features simplified design

D-50 Hydraulic and mechanical losses are held to a minimum in a simplified self-priming centrifugal pump developed by Ralph D. Carter Co. It is described as having only two components inside the volute case—the impeller and the seal. Efficient design is said to provide greater capacity, faster priming, and more trash handling ability. Adjustment for impeller wear can be made without disassembling or replacing interior parts. Sizes from 1½ to 10 in. for 5500 to 250,000 gph are available with gasoline or diesel engines, electric drives, or belt drives. Construction is shown in a bulletin.



Pneumatic atomizing nozzles provide high capacities

D-51 Pneumatic atomizing nozzles, developed by Spraying Systems Co., are said to provide higher capacities than heretofore available in this type of nozzle. The units operate at pressures of 6 to 90 psi, provide capacities ranging from 4 to 20 gpm, and are supplied with or without shutoff needles.

Electronic control features wide range of adjustment

D-52 Based on the capacitive action of liquid surrounding a porcelain enamel-covered electrode, the Belmont level control, designed by the Thermo Instrument Co., provides adjustments of liquid level and high and low differentials over wide limits. The unit consists of a probe mounted at the controlled liquid, a connecting cable, and a control unit which can be located for operating convenience.

(Continued on page 34)

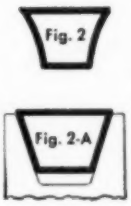
WHY
Gates V-Belts Wear Longer-

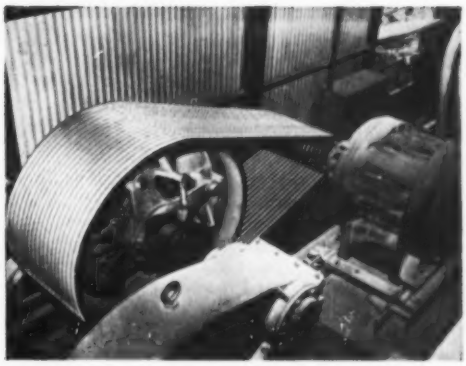
The CONCAVE SIDE (U.S. Patent No. 1813698) is what gives the Extra Wear!

Take any *straight-sided* V-Belt (Fig. 1) and bend it as it bends in going around its pulley. You will clearly see its sides *bulge out* (Fig. 1-A). These sides therefore press *unevenly* against the V-pulley and this causes extra wear at the point shown by arrows (Fig. 1-A).

Now bend a Gates Vulco Rope with CONCAVE SIDES (Fig. 2).

You will see the precisely engineered CONCAVE SIDES fill out to an exact fit in the sheave-groove (Fig. 2-A). The sides press *evenly* against the V-pulley. All wear is distributed *uniformly* across the *full width* of the Gates Vulco Rope—and this means longer belt *life* and *lower* belt *costs* for you.





Typical Gates Vulco Rope Drive—the Gates V-Belts are built with Concave Sides to insure longer belt wear.

When you buy V-Belts, be sure to get the V-Belt with the CONCAVE SIDES—the Gates Vulco Rope!

Gates Engineering Offices and Jobber Stocks are located in all industrial centers of the United States and in 71 foreign countries.

CS-533

V-Belts—Hose Molded Rubber Goods for industry World's Largest Maker of V-Belts

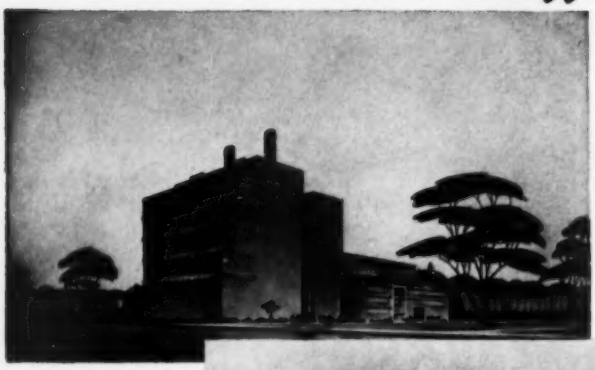
Gates® VULCO ROPE DRIVES

THE GATES RUBBER COMPANY • DENVER, U.S.A.

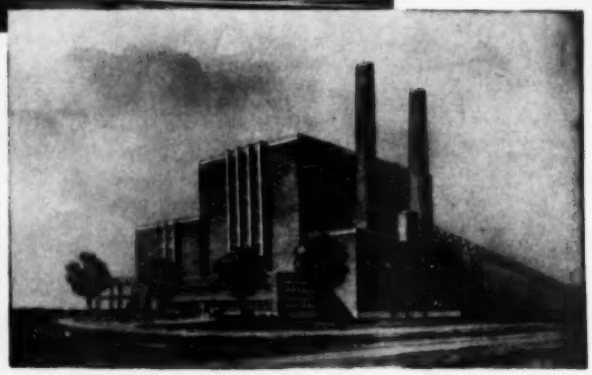
ON THESE TWO INSTALLATIONS

the AEROTEC SERIES

Assures 97.5% FLY ASH COLLECTION *Efficiency*



LEFT: The 264,000 kw (four units) J. Clark Keith Generating Station of The Hydro-Electric Power Commission of Ontario at Windsor, Canada. H. G. Acres & Co., Niagara Falls, Ontario, Consulting Engineers.



RIGHT: The 400,000 kw (four units) Richard L. Hearn Generating Station of The Hydro-Electric Power Commission of Ontario at Toronto, Canada. Stone & Webster Engineering Corp., Boston, Mass., Engineers and Constructors.

Here's on-the-job proof that Aerotec Series Mechanical-Electrical Dust Collectors are used for continuous efficiency. Guaranteed 97.5%, at normal full load the overall efficiency is anticipated as high as 99% at these two Canadian generating stations of The Hydro-Electric Power Commission of Ontario. Aerotec Series Collectors serving each plant combine a design 3RAS Mechanical and an Electrical Precipitator.

In the Mechanical unit, small diameter, permanent molded aluminum tubes provide high efficiency. Exclusive Aerotec pocket type collecting electrodes in the Electrical Precipitator reduce reentrainment of dust in the gas stream, contributing to a sharp improvement in stack appearance. The combined actions of these units assure maximum dust collection efficiency. Many Aerotec Series installations verify that fact.

Your plant can eliminate dust nuisances with Aerotec equipment just as many well-known companies have done. This highly successful performance is a reliable measure of Aerotec ability to solve your dust collection problems. Write our Project Engineers today!

Project Engineers

THE THERMIX CORPORATION

GREENWICH, CONNECTICUT

(*Offices in 38 Principal Cities*)

Canadian Affiliates: T. C. CHOWN, LTD.

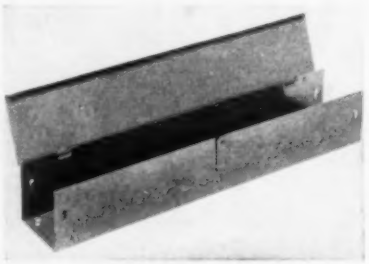
Montreal 25, Quebec Toronto 5, Ontario

THE AEROTEC CORPORATION

GREENWICH, CONN.

new equipment

(Continued from page 32)

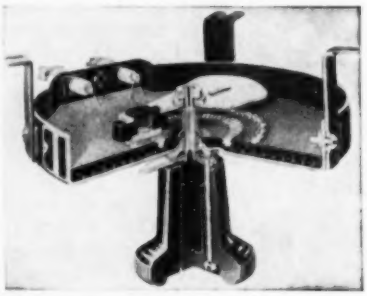


Raceway simplifies wiring

D65 Simplified installation of feeders, branch circuits, and other groups of conductors is provided by a steel enclosed wiring trough developed by Square D Co. The raceway, known as Lay-in Duct, is made in standardized sections and employs a hinged cover to provide an unobstructed working area while installing lines. Adaptor fittings are used to connect to Square Duct, panel board cabinets, or switchboards. Sizes of 2½ x 2½ in. and 4 x 4 in. are available in 1, 2, and 5 ft lengths. Construction is described in an available bulletin.

TO REQUEST ADDITIONAL FREE DATA

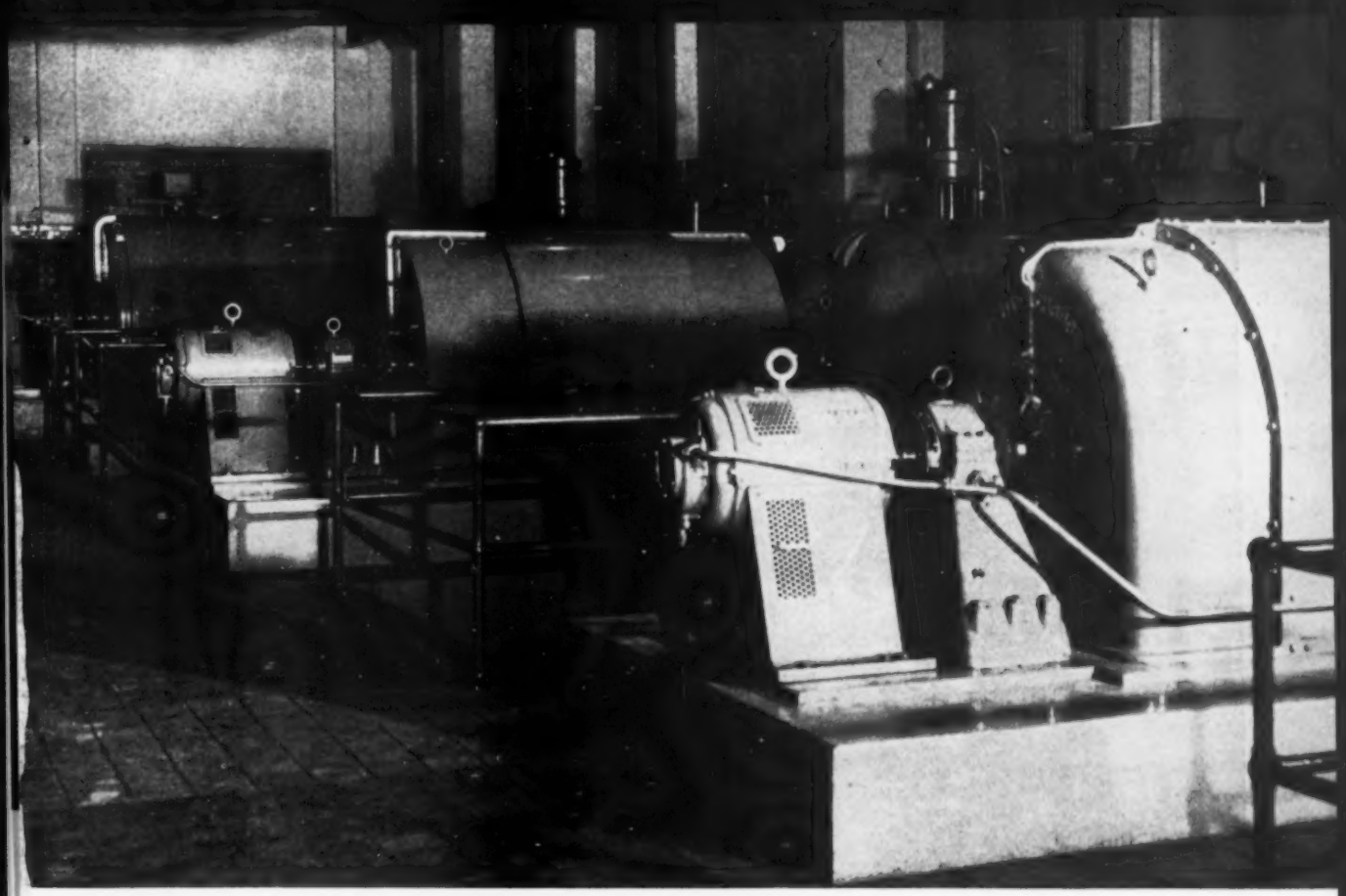
Insert "key" numbers on return post card found on page 115. Our Reader's Service Department will handle your request promptly



Rheostats provide smooth operation

D66 Smoother operation, lower operating torque, and more control steps than previous designs, are listed as design improvements for Vitrohm pressed steel rheostats manufactured by Ward Leonard Electric Co. Standard and multi-step types are available in 6, 8, and 13 in. dia. Maximum summation watt ratings are 330, 450, and 1000 respectively. Control steps per plate range from 41 to 161. Accessories and optional features are available for manual or motor-driven operation.

—*End*



Turbine oil with a past . . . and future

• The story of NONPAREIL Turbine Oil in the Water and Light Commission plant, Fairmont, Minnesota, is one of a long successful past and a guaranteed trouble-free future. It's a typical story of the kind of performance offered by NONPAREIL Turbine Oil.

NONPAREIL
TRADE MARK
Turbine Oil

In 1929, NONPAREIL got its start in this plant by solving a sludge problem in a 1500-KW unit. Water could not be separated from the conventional lubricant previously used, and sludge had resulted. Good separation was obtained with NONPAREIL, and sludge troubles were eliminated.

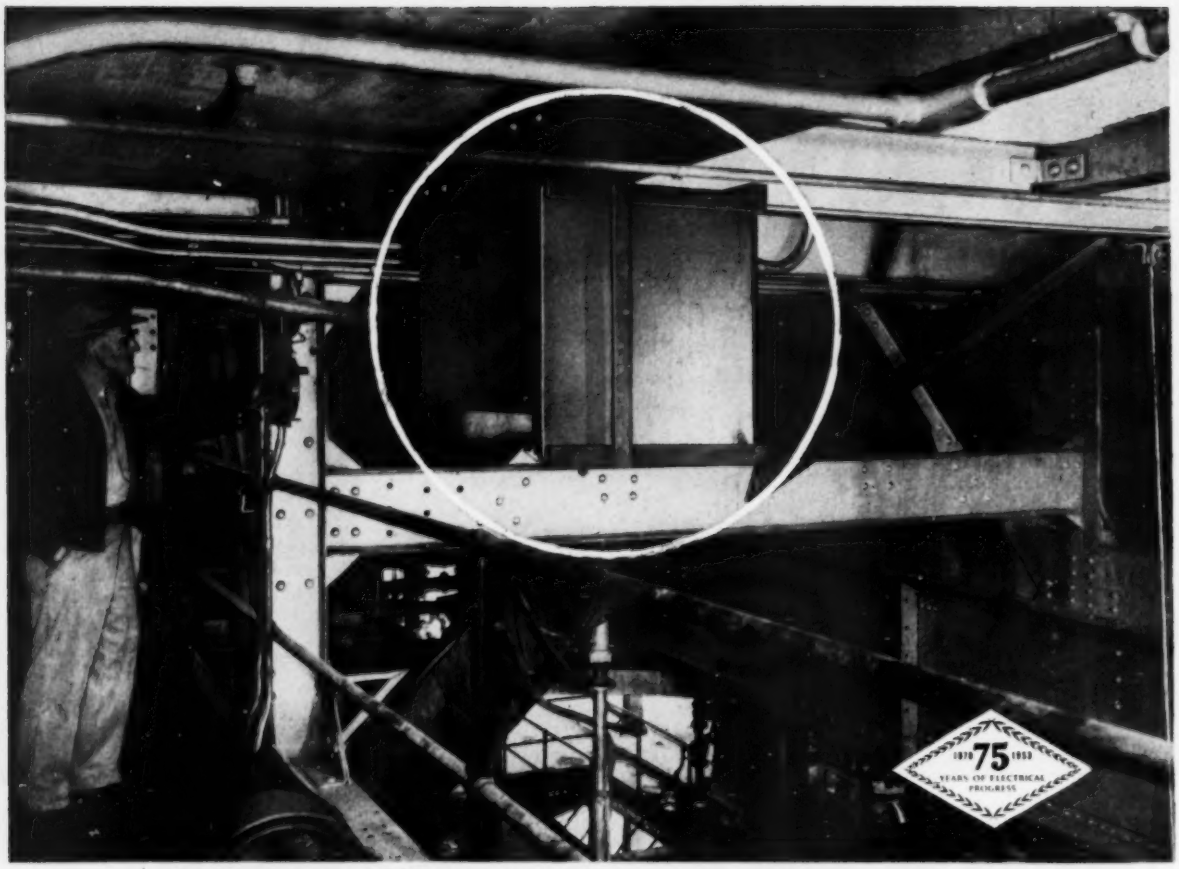
As other units were installed, they were filled with NONPAREIL—a 2500-KW unit in 1938, a 4,000-KW unit in 1945, a 4,000-KW unit in 1949.

None of the original fills of oil has ever been removed from the four turbines, either for reconditioning of the oil or for cleaning of the lubrication systems. Neutralization numbers of the oil fills have remained below 0.09 mg. KOH/gm. There have been no failures or troubles of any kind caused by faulty lubrication.

That's the past of NONPAREIL Turbine Oil in this plant—23 years of trouble-free, cost-free lubrication. What's more, the same effective lubrication is assured for the life of these turbines. Each fill of NONPAREIL is guaranteed by Standard Oil to last for the life of the turbine it lubricates and to maintain a neutralization number below 0.15 mg. KOH/gm.

A Standard Oil lubrication specialist will be glad to show you lubrication records of NONPAREIL in installations similar to your own. In the Midwest, you can contact him by phoning your local Standard Oil office. Or write: Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY STANDARD *(Indiana)*



60-kvar capacitor unit shown above is part of the 600-kvar installation that permitted a 10% increase in load.

Capacitors can be put in out-of-the-way places—such as on these existing horizontal I-beams to conserve space.

Seriously overloaded circuits take on 10% more load after G-E Capacitors are added

American Crystal Sugar Co. profits from an emergency that arose during a recent sugar refining "campaign."

During a sugar beet "campaign" which lasts from July to December, the American Crystal Sugar Company of Clarksburg, California, operates 24 hours a day. Shutdowns mean costly financial losses.

That's why the company really had an emergency on its hands when its electrical facilities became seriously overloaded in a recent campaign. However, the solution was simple. A call to G.E. brought 600 kvar of capacitors to the plant in time to prevent a "burnout."

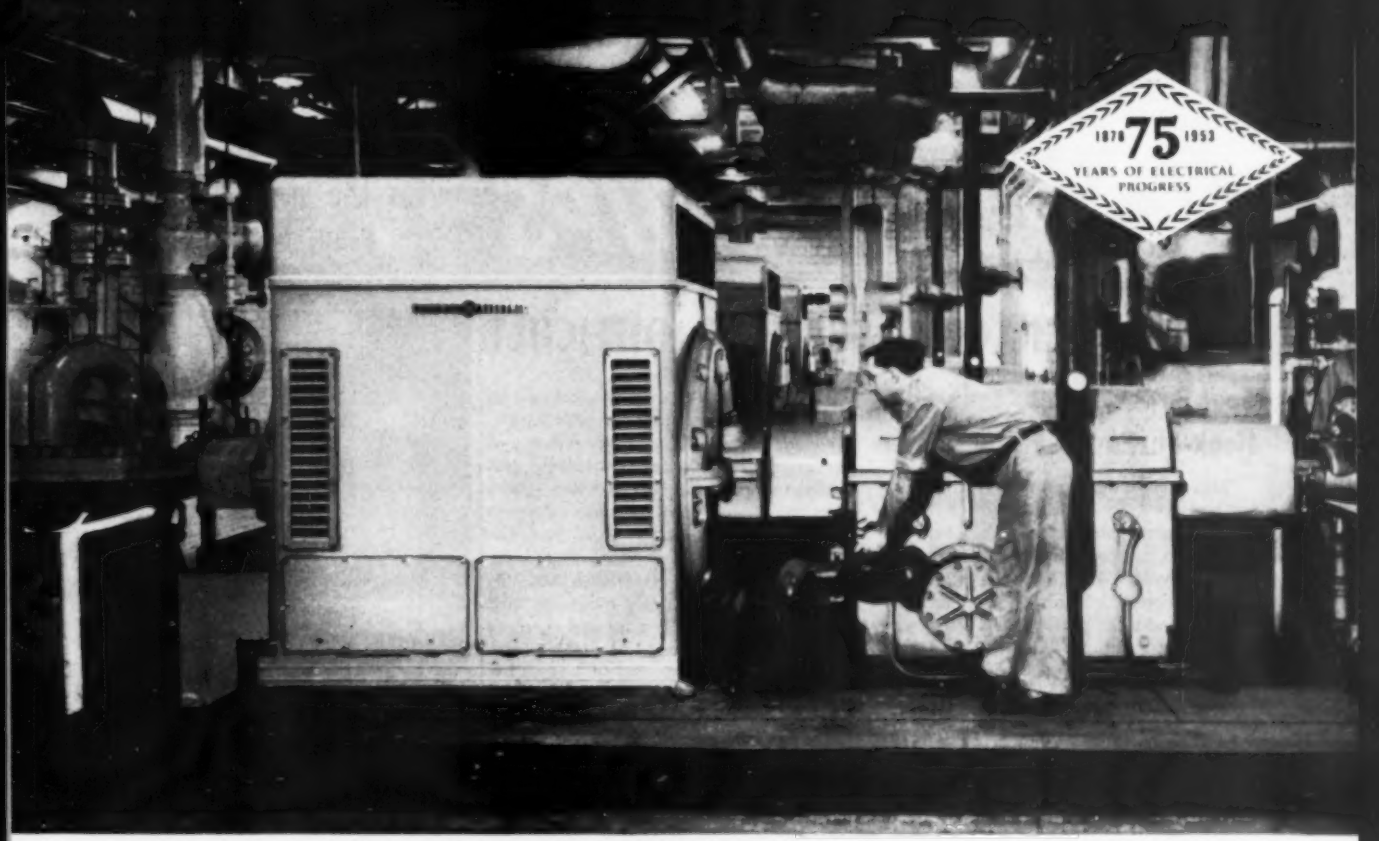
A short time after the order was placed, the capacitors were installed and in operation. The plant's power factor climbed from 86% to about 97%. This relieved the overloading—*and released enough capacity to handle a subsequent 10% increase in load!*

CAPACITORS HAVE MANY USES

They can often free distribution facilities to carry 20 to 30% more load. Where voltage drop is a problem, capacitors can provide the needed voltage boost inexpensively. And if your power factor is below 85%, and you have a power-factor or kva-demand clause in your contract, they can usually cut your power costs.

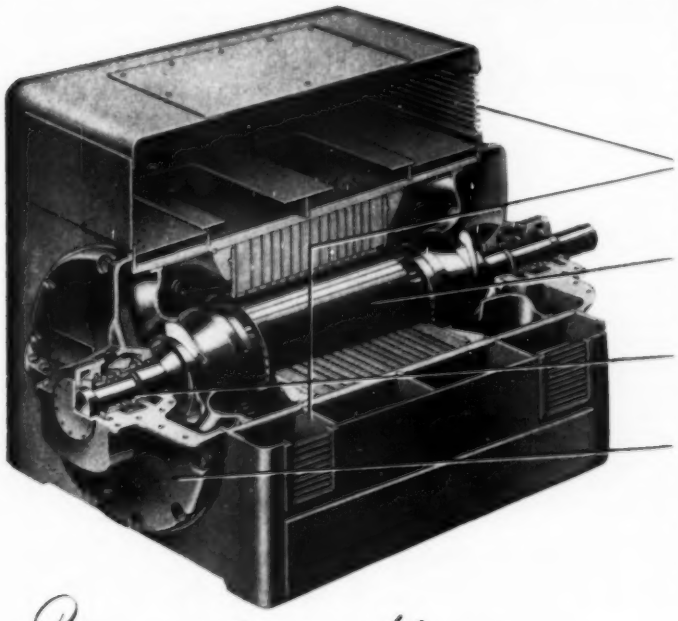
For more information, see your local G-E Apparatus sales office, or authorized G-E agent or distributor. Or write to Section 407-209 for booklet GEA-5632—"How to Reduce Power Costs and Gain System Capacity." *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC



DETROIT EDISON RELIES ON 3 G-E BOILER FEED PUMP MOTORS IN THEIR MODERN CONNERS CREEK STATION BECAUSE . . .

New G-E Boiler Feed Pump Motors Are Custom-built for Power Stations



Here's a motor designed especially for boiler feed pump service. It's a revolutionary design . . . with modern styling . . . operates quietly . . . directs discharge air away from personnel . . . conserves valuable floor space in power stations.

UNIQUE VENTILATION SYSTEM permits closer parallel spacing of motors . . . prevents recirculation of heated discharge air . . . improves personnel comfort. Air entering sides is discharged high above endshield away from adjacent motors and personnel.

STREAMLINED ROTOR construction prevents "siren" effect—built-in air deflectors and large discharge chamber cut over-all noise level.

DUAL LUBRICATION SYSTEM combines the advantages of force-flood lubrication and self-lubricated oil rings . . . gives extra protection . . . assures long, reliable bearing life.

COMPLETE 360 DEGREE ENDSHIELD supports bearing from top as well as bottom . . . assures continuous, accurate bearing lineup. Both endshield halves are sturdy ribbed castings.

For more information contact your G-E representative or write for Bulletin GEA-5813 to General Electric Co., Section 753-2, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

TESTING TIPS for the maintenance of plant equipment

FEEDER CAPACITY SURVEYS DIFFICULT

Spot Power Losses Easily with Hook-on Power Factor Meter

This hook-on power-factor meter enables you to measure power factor without interruption of service. The Type AK-3 can be used on any balanced 3-phase circuit. When making capacitor surveys, you'll find this General Electric meter a valuable time saver. Improved power factor means relief to overloaded feeder circuits and transformers.

DIRECT READING

Since the AK-3 is direct reading, no calculator cards or interpolation is required; just clip on the voltage leads, clamp the hook around the line.

Power factor is important when you are trying to obtain the maximum capacity from factory circuits. Capacitors are one of the quickest and least-expensive ways of improving power factor and increasing feeder capacity. They can permanently release up to 30% more electrical capacity in your power system. The table below shows what you can expect from adding capacitors to your feeder lines. Accurate to within 0.05 PF, the AK-3 can be used on a-c circuits with voltages from 100–600 volts and currents from 15–600 amperes. Available from stock the AK-3 is only $87.00*. Send for more information in Bulletin GEC-901.

if your power factor is now	you can release this much extra capacity	with this many capacitors for each 100 kw of load
65%	34%	84 kvar
70%	29%	69 kvar
75%	23%	55 kvar
80%	17%	42 kvar
85%	11%	29 kvar
90%	5%	15 kvar

(Power factor is raised to 95%. New load is at original power factor.)

A-C Portable Speeds Lighting Circuit Checks

General Electric's Type AP-9 (AC) and DP-9 (DC) portable testing instruments are used for production testing, maintenance work, and trouble investigations where precise measurements are required.

Their accuracy of ¾ of 1% for a-c and ½ of 1% for d-c makes these lightweight instruments well suited for quick lighting checks for under- or over-voltage, or for application in industrial and educational laboratories.

DEPENDABLE OPERATION

Large clearances between moving and stationary parts assure you of maximum dependable operation. Available in a variety of ranges in both a-c and d-c ratings, these instruments can also be obtained with pointer-stop mechanism for measurement of starting currents and voltage dips.

Price of these instruments is $42.00* and up. Send for additional information in Bulletin GEC-830.

G-E PORTABLE RECORDER IDEAL FOR VOLTAGE REGULATOR CHECKS

Pasadena Municipal Power and Light Dept. is currently obtaining satisfactory voltage checks by using the General Electric Type CF-1 recorder reports A. Leonard Stevenson, Supervisor, Meter Test Division.

REGULATORS CHECKED

Mr. Stevenson, shown in the photo above, says that regulator relays "are checked once a month to maintain standard voltages. Located in distribution centers for circuits, our CF-1's check the regulators to see that they are correctly compensated. The recorders are used whenever a circuit cut is made for adding or decreasing power. This instrument is more accurate than those previously used—its flexibility and adaptability make it a thoroughly satisfactory instrument."

30-DAY CHARTS AVAILABLE

You can get accurate records over an extended period of time with a G-E Type CF inkless recorder. Designed for dependability and maximum convenience, it can run as long as 30 days without attention, and has a weather seal for outdoor service. Simply put it on the line; it records volts, amps, or single-phase watts—just the information you need to determine what corrective action is necessary. The CF inkless recorder has an accuracy up to 1½ per cent of full scale value. Price of voltmeter (0–140/280 volts): $147.47*. More details in Bulletin GEC-215.

**Mfgr's suggested retail price.*

When ordering bulletin write to Section 602-253, General Electric Company, Schenectady 5, N. Y.

BUY NOW

From Your Nearest G-E Distributor

GENERAL ELECTRIC

Short on Erection Time—
Long on Service Life—

BYERS WROUGHT IRON PLATES

Minimum interference with production routine —during installation—and in years to come— is the story behind the selection of genuine wrought iron plate for this smokestack.

The Farrington Manufacturing Company, Boston, needed a stack for their No. 2 Plant *in a hurry*—made of a material that would *slow-down* the corrosive effect of flue gases created by the plant's incinerator and oil-fired heating boiler.

Company engineers found the answer to both problems in genuine wrought iron plate.

The stack, 100 feet high by four feet in diameter, was prefabricated in three sections at the C-W Boiler Company Shop, Holliston, Mass. These sections were trucked to the plant site, welded together, and erected in one day.

Proved corrosion resistance to flue gases and ease of fabrication and welding are outstanding characteristics of Byers Wrought Iron plate. This double advantage has recommended the material for stack use in installations across the nation, and the resulting service records provide convincing evidence of its superior durability.

How the unique character of Byers Wrought Iron plate has made it a veteran in stack service is explained in our bulletin, WROUGHT IRON FOR FLUE GAS CONDUCTORS AND COAL HANDLING EQUIPMENT. Write for your copy. It may help you in combating flue gas corrosion in your operation.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, New York.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

CONTROL PIPELINE MOTION
this dependable, maintenance-free space-saving way

6" I.D. Flexon dual controlled flexing expansion joints on 300 psi steam lines and 3" I.D. dual Flexoniflex units on condensate return line.

with FLEXON EXPANSION JOINTS

Eliminate the dangers of pipeline motion easily and permanently by installing Flexon Expansion Joints. These units are compact and easily installed. They can not leak and require no packing or maintenance of any kind. Just install them and forget them.

Flexon Expansion Joints are offered in three types—Free Flexing in copper or stainless steel for pressures to 30 psi—Controlled Flexing in copper or stainless steel for pressures to 300 psi—High Pressure Flexoniflex units in stainless steel for pressures to 5500 psi. All stainless steel pressure carriers withstand temperatures to 800° F. (1600° F. with special alloys). Copper models pressure and temperature rated according to code. All models are suitable for handling radial, axial and/or lateral pipeline motion.

Write for the name of your nearest Flexon representative.

Complete specifications on expansion joints to meet your needs are given in the new Flexon Expansion Joint Bulletin. Write for your copy today or see Flexonics Expansion Joint Catalogs in Sweet's, Chemical Engineering Catalog and The Refinery Catalog.

Flexonics Corporation EXPANSION JOINT DIVISION
1335 S. THIRD AVENUE • MAYWOOD, ILLINOIS

FORMERLY CHICAGO METAL HOSE CORPORATION
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies products of Flexonics Corporation that have served industry for over 50 years.

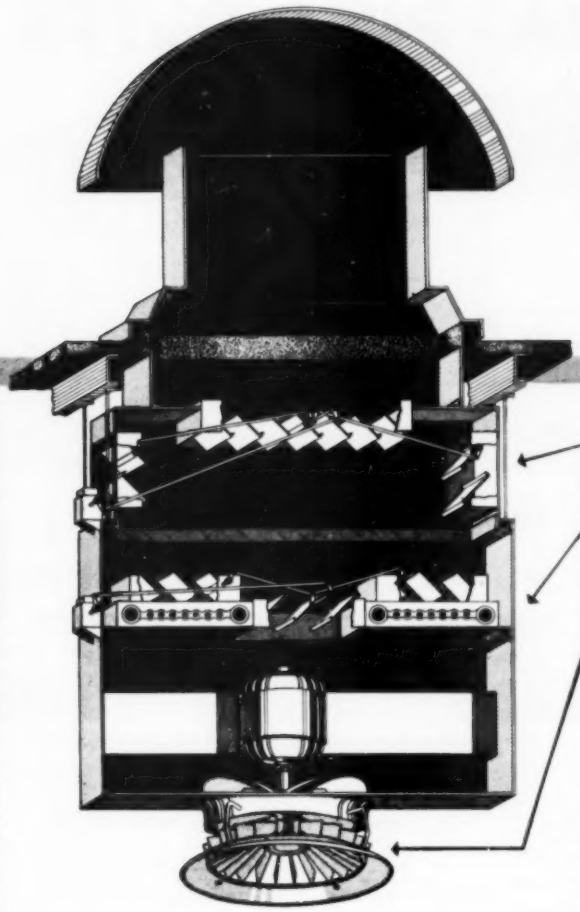
Flexible metal hose

Expansion joints.

Aircraft components

Metallic bellows

Now! Get powered ventilation and heating from a packaged unit!



TRANE VENTILATING HEATER *combines 4 basic functions in a single roof installation*

- **VENTILATES IN SUMMER**
- **HEATS IN WINTER**
- **TEMPERS OUTSIDE AND RECIRCULATED AIR**
- **ENDS NEGATIVE PRESSURE**

TRANE mixing box has fresh air and recirculating dampers. With it, you can deliver fresh, outside air alone, recirculated air alone or blend both for year-round working comfort.

TRANE heating coil and damper arrangement automatically adds heat whenever you need it to fresh or recirculated air. When ventilation alone is required, the coil face dampers are closed and the fresh air dampers in the mixing box are opened.

Patented Louver Cone Diffuser directs a powered stream of air wherever you need it. Diffuses heat gently, or pinpoints it to cold spots. Projects waste ceiling heat to floor level.

In factories, mills and foundries, the TRANE Ventilating Heater offsets negative pressure—eliminates infiltrating drafts—with powered fresh air, warmed when needed for year-round comfort or process work.

Complete packaged heating section can easily be suspended in unused ceiling space. Blackout type roof hood mounts on simple roof curb.

For full details about this versatile TRANE Ventilating Heater, see your nearest TRANE sales engineer or *write to* TRANE, La Crosse, Wis.

Solve your heating and ventilating problem with this matched line of TRANE products

TRANE Centrifugal Fan

TRANE Projection Heater

TRANE Vertical Ventilator

TRANE Model H Unit Heater

TRANE Gas-Fired Unit Heater

TRANE Torridor

TRANE roof ventilating heater

ends negative pressure . . . adds heat when you need it!

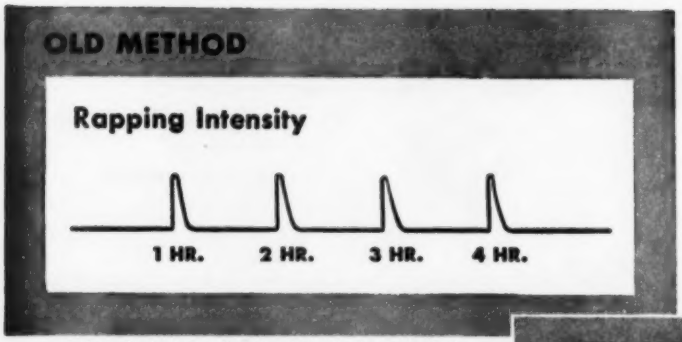
The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto • 87 U.S. and 14 Canadian Offices

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

New Development

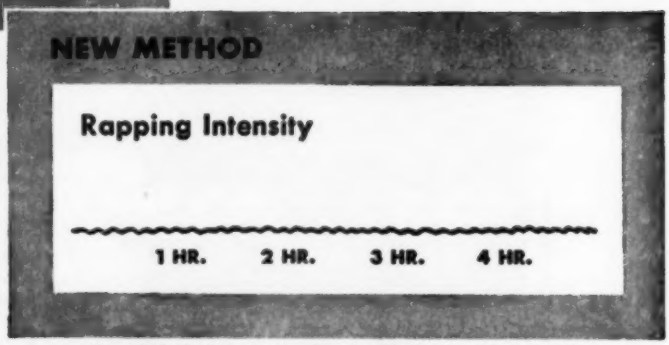
FOR ELECTRICAL PRECIPITATORS

ELIMINATES RAPPING PUFFS



Old Method of Rapping Resulting in Rapping Puff

Here are two simple diagrams that clearly demonstrate the importance of the new method of rapping developed by Research Corporation. The first shows the old way in which dust is shaken loose from electrodes at *periodic* intervals, causing intermittent puffs or clouding.



New Method of Continuous Rapping Eliminating Rapping Puffs
Rapping Intensity

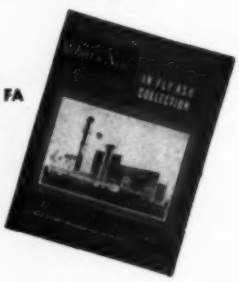
This second diagram illustrates the new scientific method of cleaning electrodes. It involves continuous or sequential rapping, every minute or less, at a controlled vibrational intensity. This converts precipitation from a batch operation to a *continuous and uniform process.*

This is another major contribution by Research Corporation to the field of electrical precipitation. Constant research and development work for the past 39 years has resulted in many other improvements over the first Cottrell Precipitator. These advances plus the unequaled experience gained through over 1000 installations, listed at right, assure you of a profitable solution to your specific problem.

RESEARCH CORPORATION INSTALLATIONS

55 Carbon Black Plants
208 Metallurgical Installations
215 Acid Plants • 34 Paper Mills
293 Detarring Installations
251 Power Stations
86 Steel Plants • 114 Oil Refineries
and Miscellaneous Installations

Want to know more about the new Rapping System? Bulletin FA contains additional data. Send for your copy.

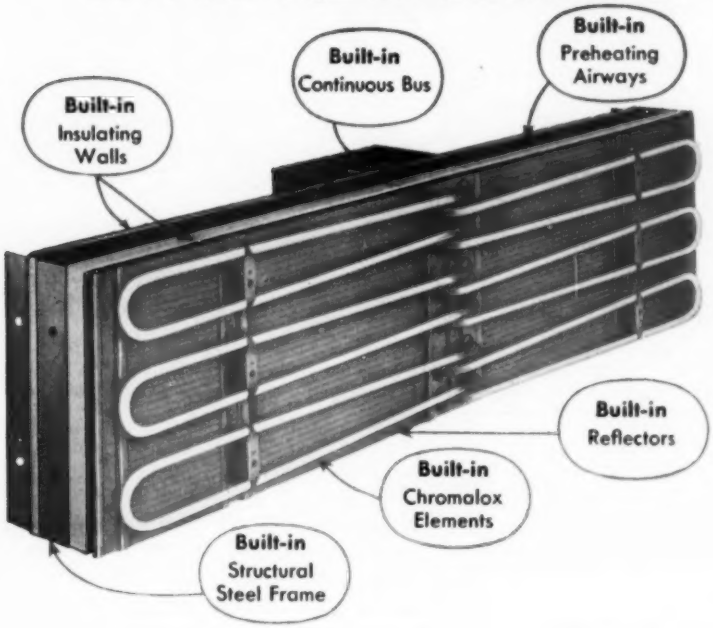


RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois
Bound Brook, New Jersey

RC-189

Announcing a new and better *INFRARED* Generator



CHROMALOX *Electric* RADIANT PANELS

Now, more efficient *far*-infrared comes in convenient pre-engineered panels, reducing oven building to a matter of determining heat requirements and assembling panels to fit the job.

CHROMALOX Electric Radiant Panels generate more uniformly absorbed *far*-infrared heat with quick heat-up and reduced oven lengths.

It's the *far*-infrared wave length that makes the difference.

- ✓ 9200 Btu's per square foot output per hour.
- ✓ Insulated for voltages to 575 V.
- ✓ Lowest installed cost per kilowatt and per square foot.
- ✓ Work temperatures to 700° F. easily obtained.
- ✓ Accurate "dialed" control.
- ✓ Absolutely uniform radiation—no hot or cold spots.
- ✓ Built to UL and NBFU requirements.

Now. . . Oven Building as Simple as

It's easy to build ovens of any desired height and length with lightweight Chromalox Electric Radiant Panels. Panels come in 1 x 4 ft. and 2 x 4 ft. sizes, ready to erect and connect with easy-to-follow instructions in each carton. Chromalox on-the-spot engineering assistance to help determine your requirements is yours—no obligation, of course.

CHROMALOX *Electric Heat*

Does More - Better - Consistently

Radiant Heating Division **EDWIN L. WIEGAND CO.,**
7520 THOMAS BLVD., PITTSBURGH 8, PA.

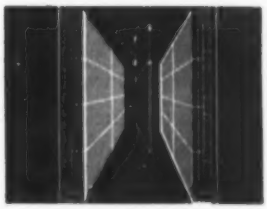
CHROMALOX FAR-INFRARED

For Baking, Drying, Curing, Dehydrating

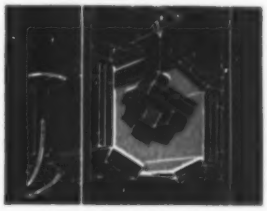
and many other applications.

9 WAYS BETTER

1. **Longer wave length**—absorbed equally fast by all colors.
2. **Shatter-proof construction**—nothing to break and contaminate.
3. **Non-diminishing output** from all-metal Chromalox tubular heat generators.
4. **Uniform heat**—no hot or cold spots.
5. **High intensity radiation**—with more watts per square foot.
6. **Quick heat-up** with energy transformed instantly into heat on the work.
7. **Low-cost oven assembly.**
8. **Infinitely variable output**—from 0 to 100% of capacity.
9. **Additionally safe** for any work involving volatiles.



Easily erected banks of Chromalox Radiant Panels are ideal for line production. Far-infrared heat is radiated directly and uniformly without hot spots over entire work area.



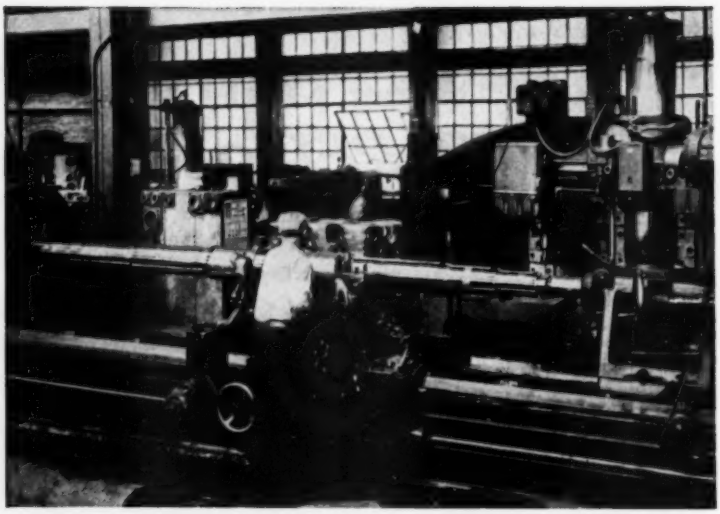
Chromalox Radiant Panels can be erected into any oven shape. Rugged construction permits their use in assembly lines, even when hazards of splashed liquids, volatiles and moisture are present.

Get this Bulletin

It contains complete information, specifications and application ideas for the use of Chromalox Radiant Panels. Write for your copy today.

IC-66

When you need a tough, fatigue- and corrosion-resisting alloy —try "K" Monel



This is the largest INCO Nickel Alloy pump shaft in the world. The shaft is 13 feet 7⅛ inches long, 9.005 inches at its widest diameter, and weighs 3,343 lbs. It was forged by INCO'S Huntington Mill from "K" Monel for Consolidated Edison Co., after other materials repeatedly failed.

Are there applications in your operation where metal is subject to fatigue, corrosion and erosion?

Then chances are "K" Monel is the alloy you need.

"K" Monel is a tough, corrosion-resisting wrought alloy of Nickel, copper and aluminum. It offers you the excellent corrosion resistance of regular Monel, together with the added advantages of greater stiffness and hardness through heat treating.

As evidence of the value of "K" Monel's added advantages, take a pump shaft operating in highly corrosive and polluted salt water.

New York City's Consolidated Edison Company has two big 80,000-gallon-per-minute condenser circulating water pumps. For years engineers kept replacing the shafts with materials of increasing strength but failures would continue to occur in the same spot because of corrosion fatigue.

Finally, they decided to try "K" Monel.

A 1½-ton heat-treated "K" Monel shaft with a tensile strength of 140,000 pounds per square inch was installed in September of 1949 and has been functioning perfectly ever since. In fact, the pump casing has not even been opened for inspection since installation.

Let's take a quick look at a few of the principal characteristics of "K" Monel:

Age-hardenable, or capable of having its hardness and mechanical properties increased simultaneously as the result of thermal treatment, "K" Monel is equal in strength and toughness to many heat-treated alloy steels. It shows improved strength and hardness at sub-zero temperatures with no loss of toughness. And it provides moderate strength at temperatures up to 900° F.

"K" Monel is non-magnetic under ordinary conditions, and remains so down to —150° F.

The working characteristics of "K" Monel are excellent, too. It is readily machined in an annealed condition, but in other conditions may be considered commercially machinable at practical (although generally somewhat slower) rates. It can be joined by the usual welding, brazing and soldering processes.

You'll find all essential engineering data on "K" Monel and its more machinable companion alloy, "KR" Monel, in the 24-page reference manual, "Engineering Properties of 'K' Monel and 'KR' Monel." Write for your copy.

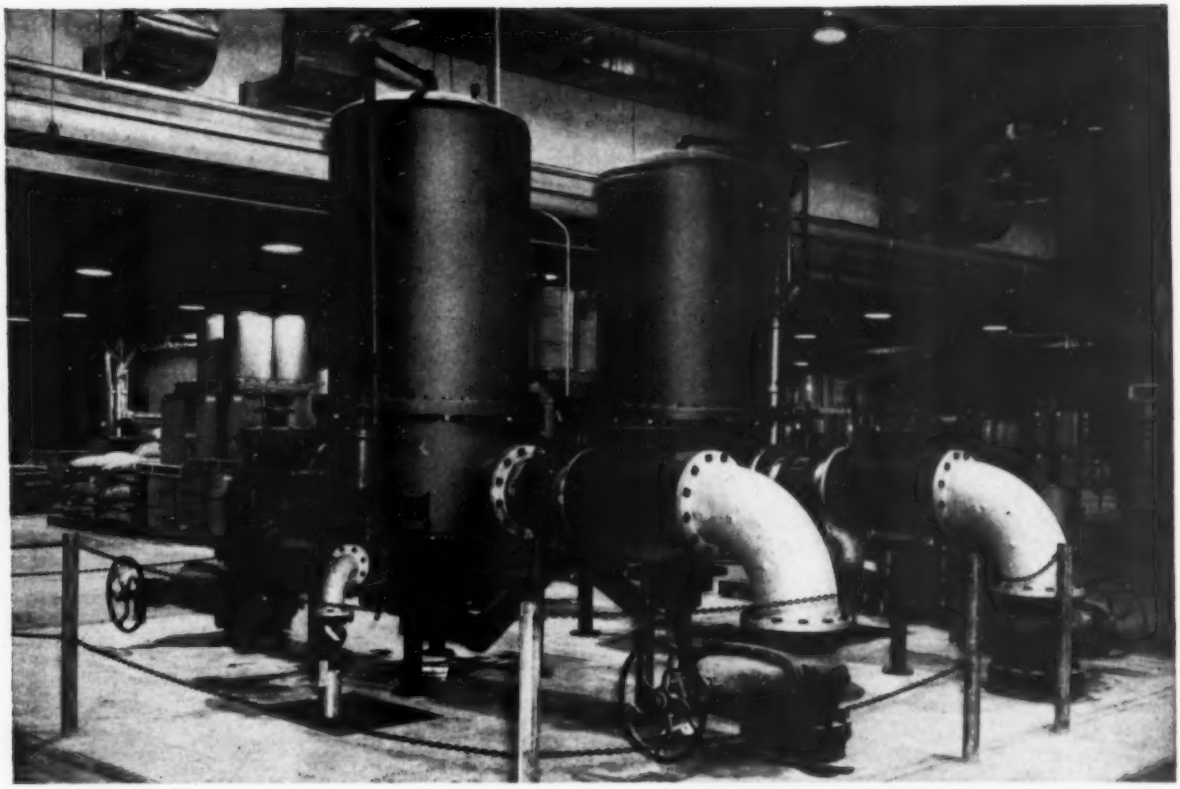
At present, INCO Nickel Alloys are in great demand for defense purposes. It pays to anticipate your equipment needs as far in advance as you can, and then place your orders with suppliers at once.

The International Nickel Company, Inc.

67 Wall Street, New York 5, N. Y.

Nickel (INCO TRADE MARK) Alloys

MONEL® • "R"® MONEL • "K"® MONEL "KR"® MONEL • "S"® MONEL • NICKEL • LOW CARBON NICKEL • DURANICKEL® • INCONEL® INCONEL "X"® • INCONEL "W"® • INCOLOY® • NIMONICS®



EVERY GRAIN OF SAND IS REMOVED from the well water passing through these abrasion-resistant FLO-KLEAN filters at the new Upjohn Company plant in Kalamazoo, Michigan.

Upjohn saves 2000 dollars a month

FLO-KLEAN filters protect valuable equipment at pharmaceutical plant

Maintenance records at the Upjohn Company's ultra-modern plant near Kalamazoo, Michigan, show that FLO-KLEAN filters are responsible for saving up to $2000 a month in maintenance costs.

These Cuno FLO-KLEAN filters, used to remove sand and gravel from incoming well water, ordinarily take something like a teaspoon of sand out of each thousand gallons. That doesn't appear to be an impressive quantity, but it could cause serious damage to stainless steel valves, pumps, water softeners, condensers and other valuable equipment. Purity of process water is assured by the high-capacity FLO-KLEAN units.

Recently the wall of one of their thirteen 250 feet deep wells gave way, dumping large quantities of sand and gravel into the water system. Every bit of this sudden deposit (almost seven cubic yards) was removed by the FLO-KLEAN filters. Without interrupting service, FLO-KLEAN continued its automatic operation and saved Upjohn a serious operating and maintenance loss.

In hundreds of applications throughout industry the fully automatic, continuously self-cleaning FLO-KLEAN filters have paid for themselves many times over by making river, lake, or well water fit for industrial use . . . and without loss of backwash water. Other uses include reclaiming industrial process water and coolants. If you need or use between 200 and 100,000 gallons per minute of clean water, find out how FLO-KLEAN can save you money. Write for free FLO-KLEAN bulletin to the Cuno Engineering Corporation, Dept. 141-F, Meriden, Conn. 3.1

CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

LETS EXPANSION KEEP ON THE MOVE

PENFLEX TUBING

ABSORBS THERMAL EXPANSION...PROVIDES FLEXIBILITY

Write for this helpful folder, "Flexineering."

Coal dust showers over equipment, floors and lines were regular occurrences in one large power plant. Thermal expansion moved steel tubes feeding powdered coal to the burners of high pressure steam boilers.

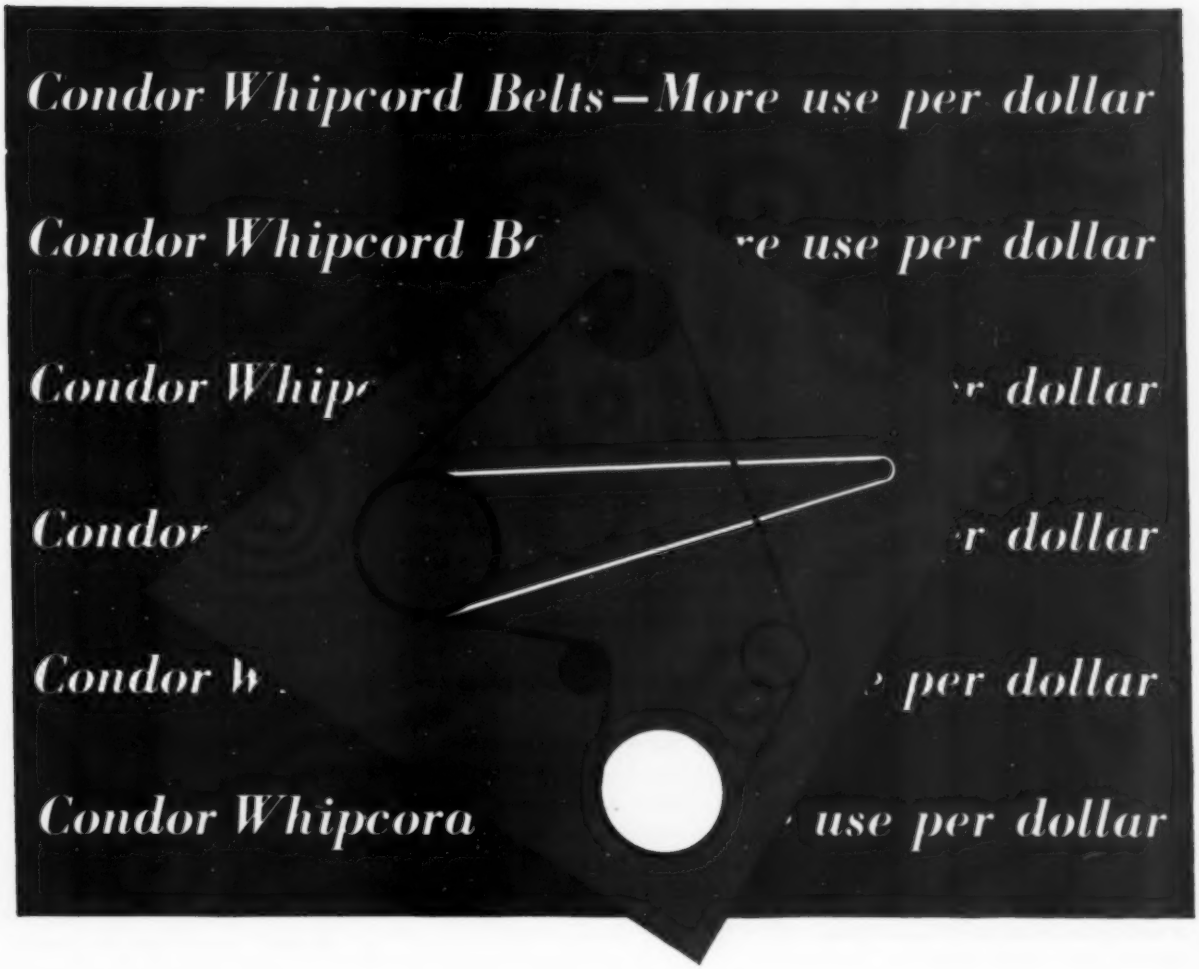
Then Penflex "Flexineering" recommended a flexible steel "overcoat" for the rigid steel feed pipe. Lengths of 20″ and 24″ I.D. interlocking, galvanized steel tubing were installed. Penflex tubing now forms a flexible seal between the hopper and tube, assuring protected delivery of powdered fuel.

Let Penflex "Flexineering" help you on tubing problems. Penflex manufactures a complete line of four-wall, interlocking and seamless welded corrugated flexible tubing . . . metallic hose, tubing or couplings from 1/8″ I.D. and up . . . automatic barrel fillers, pneumatic rivet passers, accessories and fittings.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7238 Powers Lane, Phila. 42, Pa.
Branch Sales Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

PENFLEX

HEART OF INDUSTRY'S LIFE LINES



ENDLESS BELTS BUILT TO TAKE THE TURNS . . . Designed for "Belt-killer" drives, Condor Whipcord Belts save you money on all endless belt drives. They are specially engineered for short centers, small pulleys, reverse bends, high speed, high tension. They are practically unaffected by variations in atmosphere—no shrinkage—no stretch on the drive. This saves you downtime for belt take-up. The R/M Extensible-Tip cover-end splice eliminates cover separation. You get MORE USE PER DOLLAR. Ask the R/M distributor for Bulletin 6869. He can help you get MORE USE PER DOLLAR too with R/M hose, conveyor and V-belts.

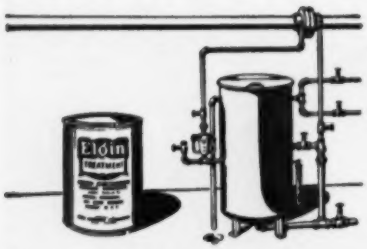
R/M

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

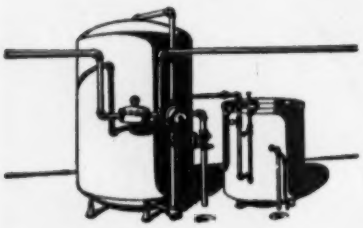
Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Teflon Products • Packings • Sintered Metal Parts • Bowling Balls

Which of these methods will best fit your water conditioning needs?



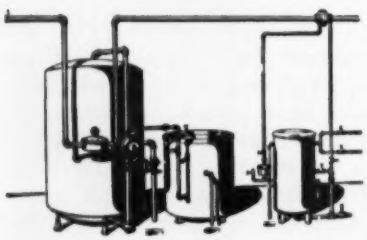
1 CHEMICAL FEED

In many cases, individually prepared Elgin Chemical Treatment alone will effectively prevent scale formation and corrosion.



2 ZEOLITE SOFTENING

A zeolite water softener will efficiently eliminate hardness, scale, and lime deposits.



3 ZEOLITE – POST TREATMENT

A zeolite softener, supplemented by chemical treatment will not only eliminate hardness, but will also prevent corrosion.

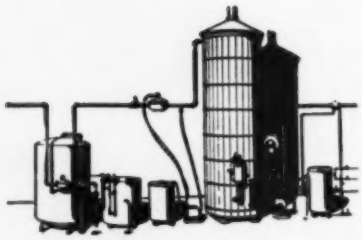
FOR AN UNBIASED ANSWER . . . CALL YOUR ELGIN MAN

Chances are that one of these basic Elgin systems will fit your water conditioning needs. If not, there is no limit to the number of systems we can "tailor" to your exact requirements and budget.

Whether a simple chemical feed system, a zeolite water softener, one of the many ion-exchange combinations, silica and CO_2 removal, or deionization for the highest quality water known today — you may be sure Elgin can provide the type of system required to produce water of the exact characteristics you require.

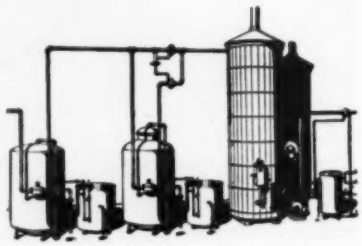
Nearly a half century of water conditioning experience is yours for the asking

Most important is the fact that Elgin's skill and experience, gained through nearly a half century devoted exclusively to the field of water conditioning, is yours for the asking — through our district engineer in your vicinity. Write, wire or phone, and we will put him in touch with you.



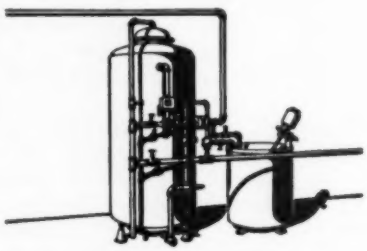
4 ZEOLITE – ALKALINITY NEUTRALIZATION

Water of low-controlled alkalinity, with CO_2 removed, can be produced by acid feed and degasification following zeolite softening.



5 SODIUM – HYDROGEN SOFTENING AND DEGASIFICATION

Blended effluents from a sodium zeolite softener and a hydrogen zeolite softener, followed by degasification, give water in which total solids and alkalinity is reduced and CO_2 is removed.



6 DEIONIZATION INCLUDING SILICA AND CO_2 REMOVAL

Single-tank Ultra-Deionizer produces the equivalent of distilled water, free from silica and CO_2, at amazingly low cost.

ELGIN
SINCE 1908
WATER CONDITIONING FOR EVERY NEED

ELGIN SOFTENER CORPORATION
138 North Grove Avenue, Elgin, Illinois
REPRESENTATIVES IN PRINCIPAL CITIES

How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

Correct installation cures many packing troubles

Danger! Don't mix me with old packings

Old packings may look all right, but often they are so dry and highly compressed that they may cause scoring. Play it safe and remove *all* old packing before putting new packing in place. Be sure to remove accumulations from stuffing box walls, gland follower and shaft. New packing is cheaper than new rods, shafts and sleeves!

Make sure I'm the right size

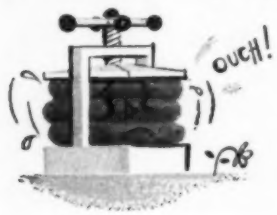
Packing that's too small may turn with the shaft. Oversize packing may cause excessive pressure and subsequent scoring. To find the correct size, check the rod or shaft diameter and the inside diameter of the stuffing box—then choose a packing to fit. In this way, allowance is automatically made for wear of the rod.

Seat me one ring at a time

Never load the stuffing box with packing rings and try to seat them all at once by tightening the gland follower. This invites trouble due to excessive gland pressure. Always install one ring at a time, making sure it's properly seated *before* the next ring is installed.

Don't squeeze me too tight!

Too much gland pressure is a common cause of packing failures. After the packing is installed, pull up the follower only sufficiently tight to insure seating of the last rings installed. Then back it off, leaving the nuts finger-tight. Don't worry about a little leakage. Actually, it's good assurance that the packing isn't too tight in the stuffing box. Besides, the liquid frequently has some lubricating qualities.



Why you can expect longer life from

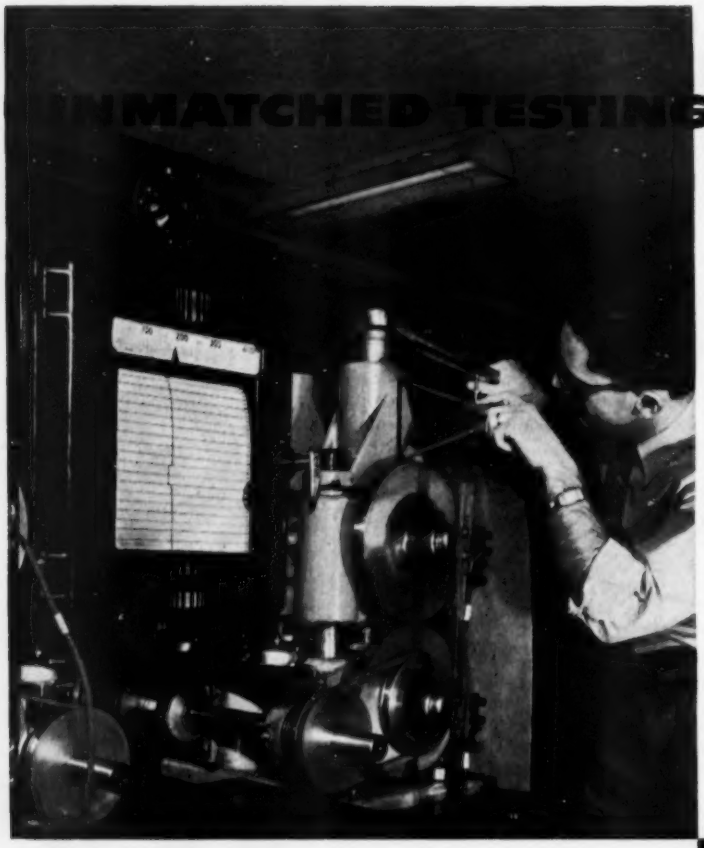
NAVALON Style No. 190

Made from specially processed ramie—nature's strongest fiber—Navalon stands up in severe service where other cold-liquid packings fail. It gives outstanding performance in pumps, elevators, accumulators, presses, and on reciprocating rods and plungers operating against fresh or salt water, brine, cold oil and many other liquids.

Your distributor will help, too! Your J-M Packing Distributor can help you take the guesswork out of packing problems. He carries complete stocks of Johns-Manville quality packings and can supply you promptly. For the address of the J-M Packing Distributor nearest you, write Johns-Manville, Box 60, New York 16, N. Y.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

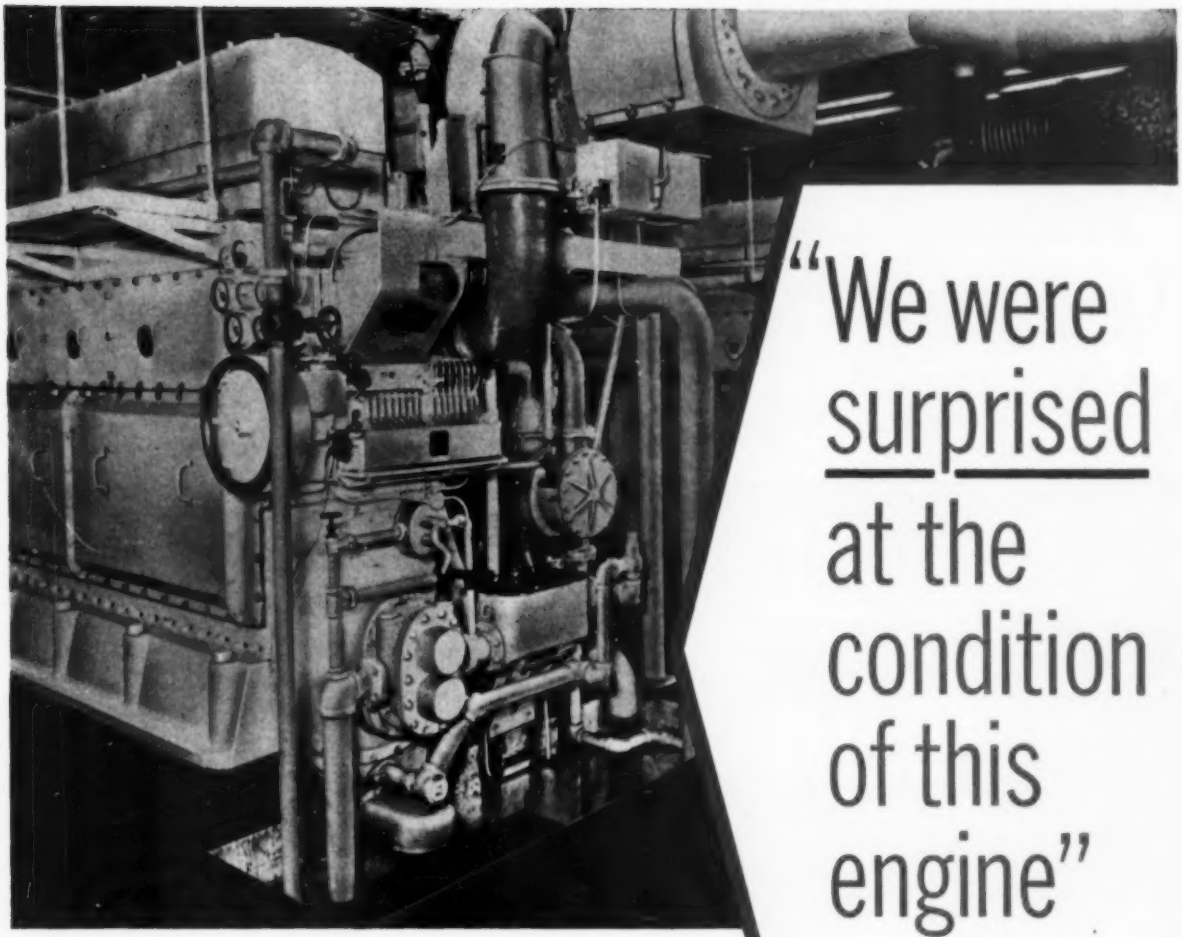


UNMATCHED TESTING FACILITIES...

one of many reasons for Hyatt leadership!

In testing laboratory or manufacturing plant, Hyatt's facilities are second to none. Continuing research in methods and materials, and exacting inspection with the finest in modern equipment, has made the Hyatt name a synonym for "highest quality." That's why Hyatt Roller Bearings are so widely used in design applications involving radial loads. Design engineers know that Hyatt bearings have been "performance-proved" for smoother, trouble-free operation and longer life. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS



"We were surprised at the condition of this engine"

... says G. V. Yarger,
Supt. Municipal Utilities
Waverly, Iowa

"When we finally opened up our Worthington, it was in the *best* condition I've ever seen a diesel engine that had operated such long hours and under such heavy loads as this unit. It had a total of 48,926 hours on it – 8,987 hours of tough operation since the last overhaul.

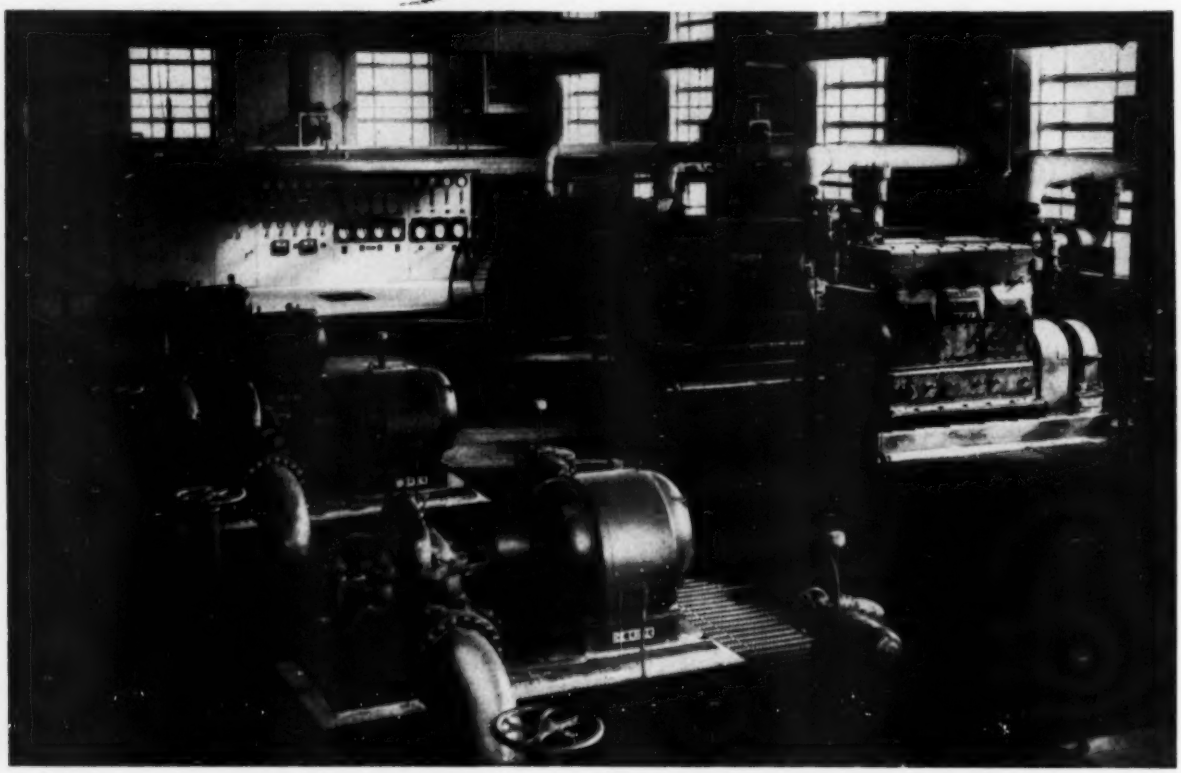
Mr. Yarger continues, "We've been using Sinclair RUBILENE® Heavy in the crankcase and RUBILENE H.D. 30 in the cylinder lubricator. These RUBILENES have kept the crankcase and upper portions of the cylinders exceptionally clean and bright, with no sign of carbon or deposits."

That's a typical report on the exceptional qualities of the Sinclair RUBILENES . . . evidence that they could improve the efficiency of *your* diesels, too. Why not switch now? Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL OILS

save wear and replacements

DE LAVAL FIRE PUMPS *on the job at Idlewild*



Ten De Laval centrifugal pumps, with a total capacity of 34,000 gpm, play a vital role in the deluge fire-fighting system of the New York International Airport at Idlewild, Long Island.

The installation is composed of two 2,500 gpm and three 4,000 gpm motor-driven pumps as well as two 2,500 gpm and three 4,000 gpm diesel-driven units, which are used for standby service. When the normal operating pressure drops from 165 psi to 140 psi or less, the electric pumps go to work automatically. The diesels are brought into service as necessary.

Efficient De Laval centrifugal pumps are serving water works and fire-fighting stations all over America. These pumps are available in capacities ranging from less than one million gallons per day to more than 100 million gallons per day.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
857 Nottingham Way, Trenton 2, New Jersey

DL 177

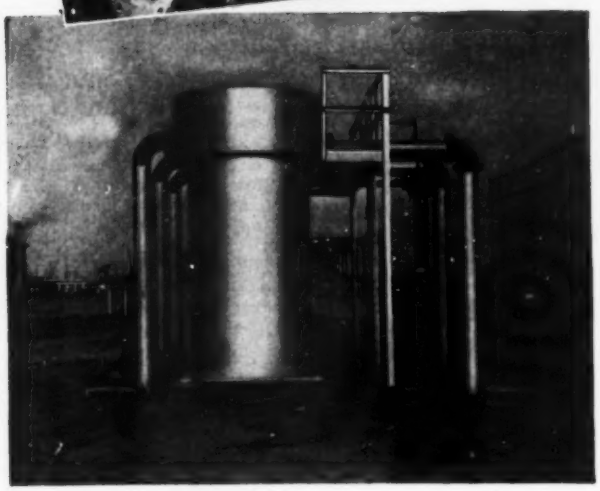
Dirty Water can't "Shut-down"...

Vogt

film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

ONLY SPENCE REGULATORS

...give you all these design advantages

Separate Interchangeable Pilot . . .

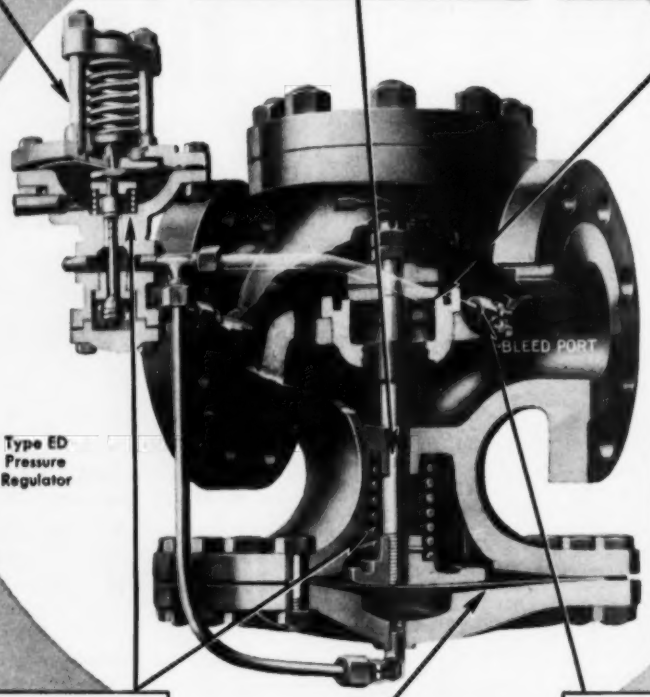
controls main valve . . . simplifies inspection and maintenance.

Packless Construction . . .

minimizes friction . . . improves control accuracy and eliminates much time-consuming maintenance.

SECO Metal Seats and Discs . . .

resist wiredrawing. More than 20 years of experience has failed to produce a single case where SECO Metal was cut by steam.



Type ED Pressure Regulator

Dead-End Shutoff . . .

guaranteed on steam service when a balanced, single-seated main valve is equipped with SECO Metal seat and disc and is protected by an approved strainer.

Internal Springs . . .

out of path of steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life.

Large Balanced Metal Diaphragms . . .

located in a cooled zone with a condensate seal above and below, under usual conditions, never need replacement.

Ease of Inspection . . .

quick access to all vital elements of regulator. No special tools needed.

These Spence design features explain why Spence Regulators function dependably and accurately year after year, without requiring extensive repairs or special attention. This lowers over-all costs . . . means less down-time of the system. • Spence makes a complete line of automatic regulating valves: pressure reducing, differential pressure, back pressure control, pump governor, temperature regulating and other types. Write for Bulletin giving full details.

Spence

SPENCE ENGINEERING COMPANY, INC.

WALDEN, NEW YORK

"Ain't She A Beauty?"

. . . to quote a customer

Justin R. Whiting Plant, Consumer's Power Company, Erie, Mich.
Insulation Contractor: Service Products Inc., Toledo, Ohio

Insulation That's Both Smooth And Efficient

You can get a neat, shipshape installation every time with one strong, lightweight material — Kaylo Heat Insulation (hydrous calcium silicate).

You get greater efficiency, too. Note suggested thicknesses at the right—compare with combination thicknesses of other materials commonly used.

With its one-material coverage up to 1200° F. plus an unmatched selection of sizes and shapes, Kaylo Insulation saves on material as well as application. At the same time it gives you a job that's better in performance . . . better in *appearance*. Get all the facts.

SUGGESTED THICKNESSES:

NOMINAL PIPE SIZE—IRON	TEMP. DIFFERENCE HOT SURFACE TO AIR DEG. F										
¾	1	1	1	1½	1½	1½	2	2	2½	3	3
1¼	1	1	1	1½	1½	2	2	2½	2½	3	3
1½	1	1	1	1½	1½	2	2½	2½	3	3	3
2	1	1	1½	1½	2	2	2½	2½	3	3	3
2½	1	1	1½	1½	2	2½	2½	3	3	3	3½
3	1	1	1½	1½	2	2½	2½	3	3	3½	3½
3½	1	1	1½	2	2	2½	3	3	3½	4	4
4	1	1	1½	2	2	2½	3	3	3½	4	4
5	1½	1½	1½	2	2	2½	3	3	3½	4	4
6	1½	1½	1½	2	2	2½	3	3½	3½	4	4½
10	1½	1½	1½	2	2	2½	3	3½	4	4	4½
12	1½	1½	1½	2	2½	3	3	3½	4	4½	5
14	1½	1½	1½	2	2½	3	3	3½	4	4½	5
16	1½	1½	1½	2	2½	3	3	3½	4	4½	5

WRITE FOR FREE BOOK—"Kaylo Heat Insulation." Address: Dept. N-407, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO®

. . . first in calcium silicate

. . . pioneered by OWENS ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • CHICAGO • HOUSTON • NEW YORK • PHILADELPHIA • PITTSBURGH • ST. LOUIS

Your Management wants to know...

The practical approach to dust abatement

PLANT ENGINEERS, working with Buell engineers, have proven again and again that their know-how coupled with Buell's long experience in Dust Collection can solve your Fly Ash problems more economically, more efficiently.

What's more, Buell Dust Collection Systems offer all American industry these further advantages: smoother plant/community relations, improved product quality and better employee morale.

Buell's knowledge and experience in the highly specialized science of Dust Collection are yours. To learn more about Buell's **3 basic systems** of Dust Collection and how they can help you, send for the new, informative booklet titled, "The Collection and Recovery of Industrial Dusts." Buell Engineering Co., Dept. 90-D, 70 Pine Street, New York 5, N. Y.

VAN TONGEREN CYCLONE

'SF' ELECTRIC PRECIPITATOR

PRECIPITATOR-CYCLONE COMBINATION

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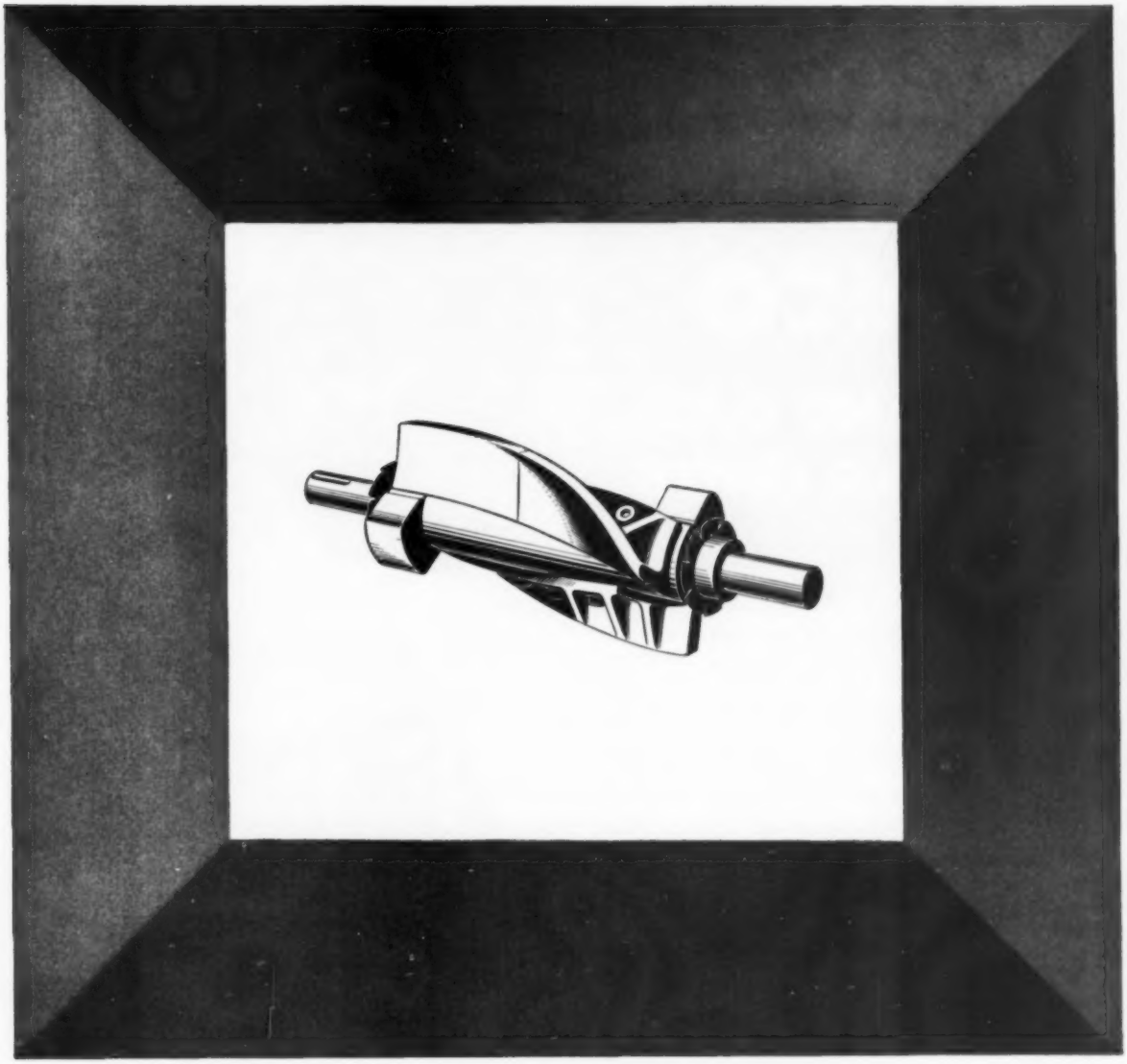

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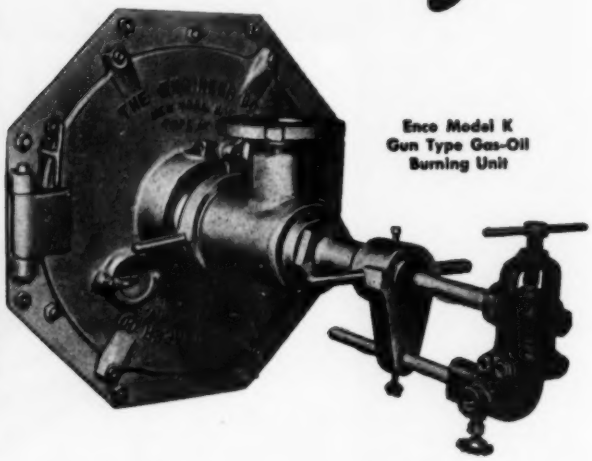

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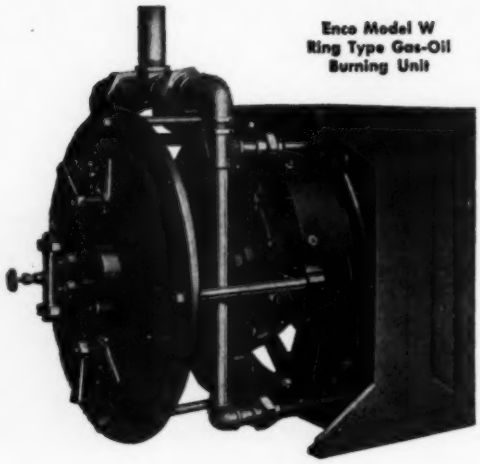

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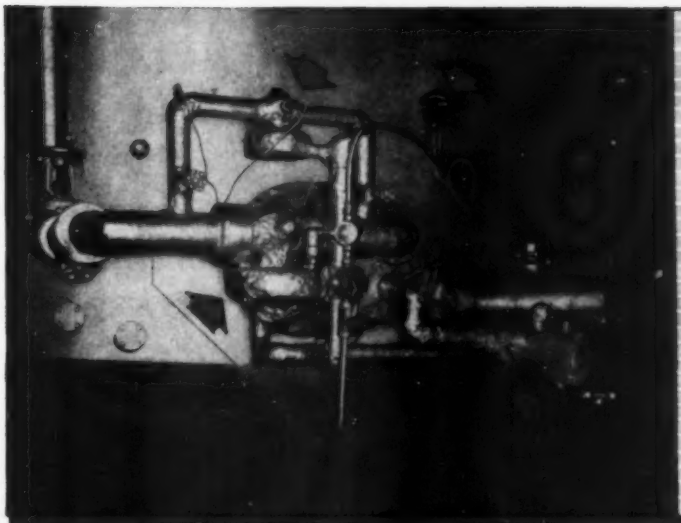
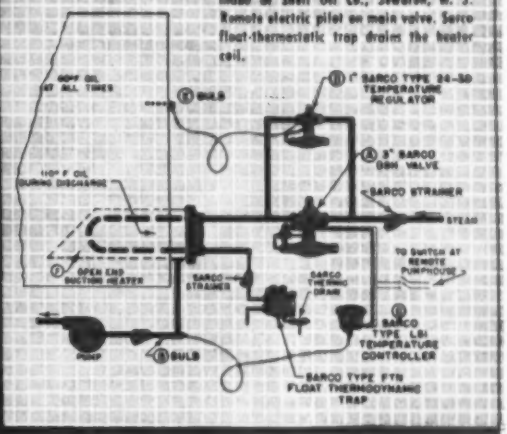


● Fig. 1. Sarco type 24-30 self-contained, pilot-operated Temperature Regulators on bulk storage tanks. One of 13 installations made at Shell Oil Co., Sewaren, N. J. Remote electric pilot on main valve. Sarco float-thermostatic trap drains the heater coil.



● Fig. 2. Sarco TR-21 self-operated Temperature Regulator on suction heater of fuel oil storage tank. Sarco No. 9 balanced pressure thermostatic steam traps drain the heater coil and drip the steam supply.

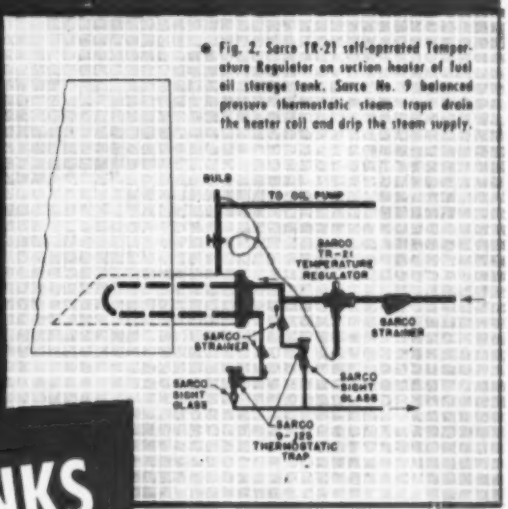


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Fig. 2 is a simplified hook-up for low pressure steam, using self-operated regulator, type TR-21

Send for a Questionnaire or write for Catalog 600-14, to Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Branches in principal cities. Sarco Canada Ltd., Toronto 8, Ont.

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Sarco pilot-operated Temperature Regulator, type 24-30 for dead-end service and high steam pressure.

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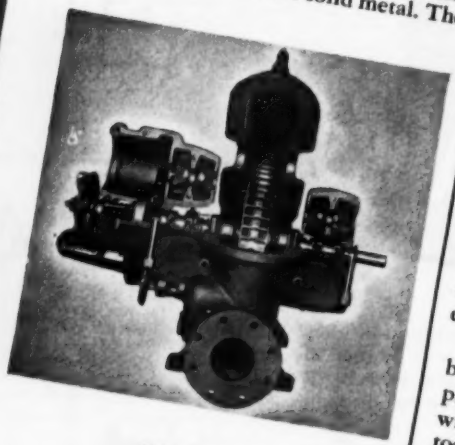

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Memo

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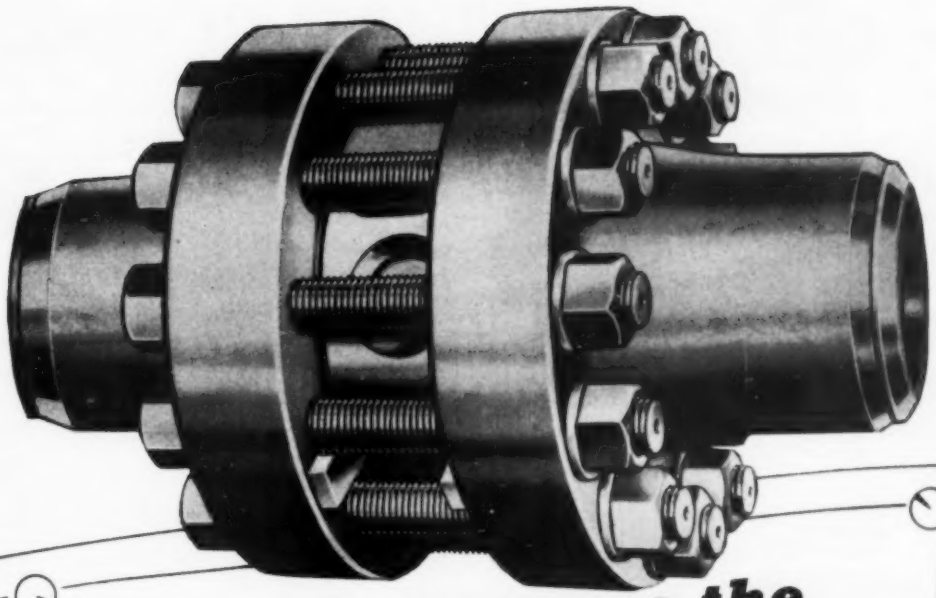

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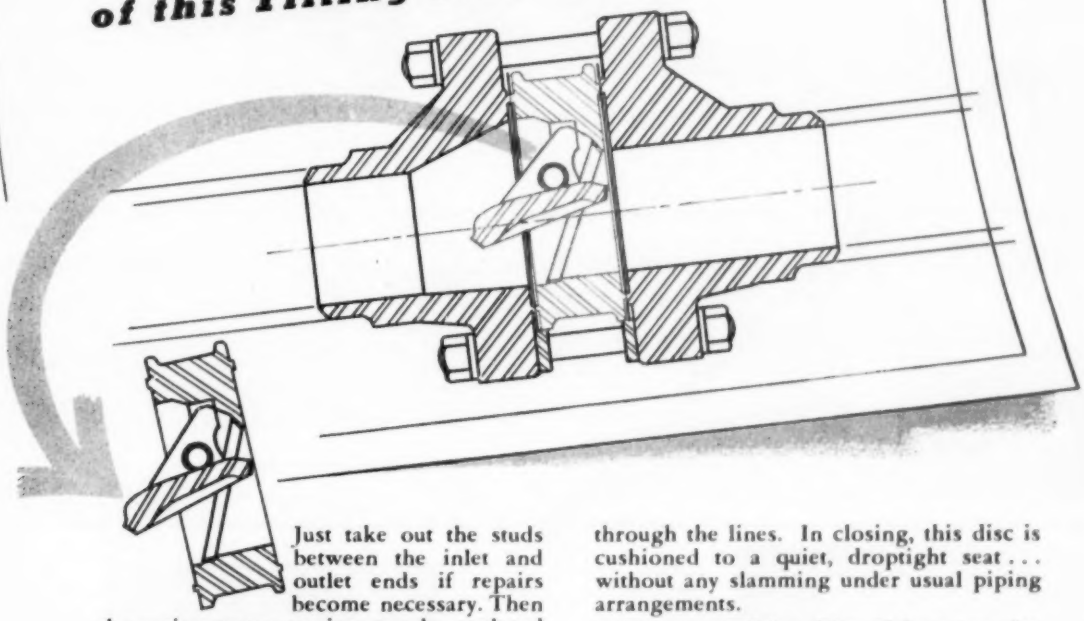

Just take out the studs between the inlet and outlet ends if repairs become necessary. Then the entire center section can be replaced . . . quickly and easily. No need to cut the valve out of a welded line.

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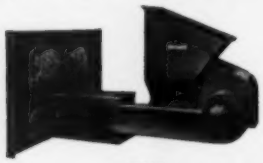

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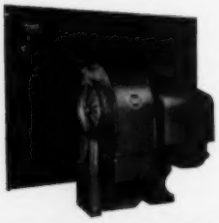

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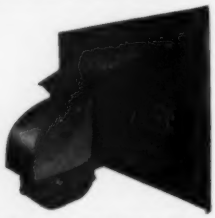

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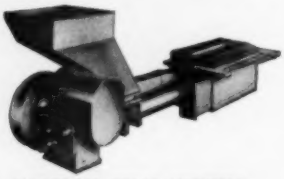

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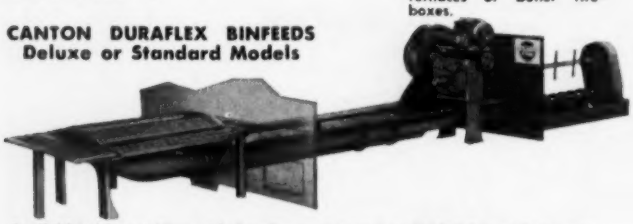

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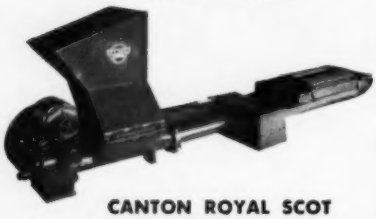

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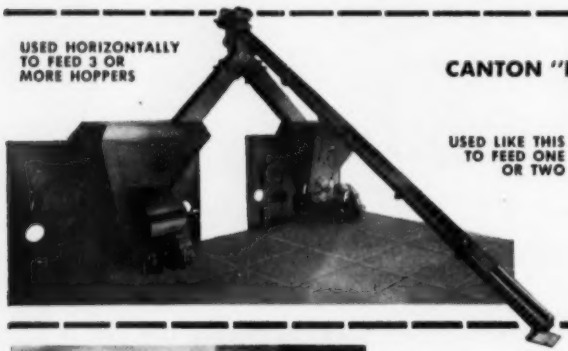

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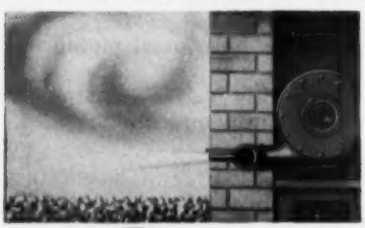

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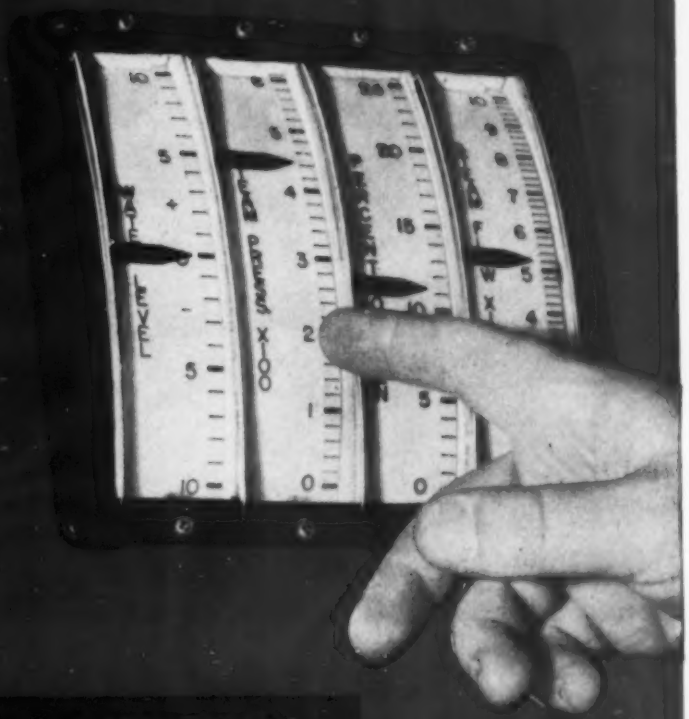

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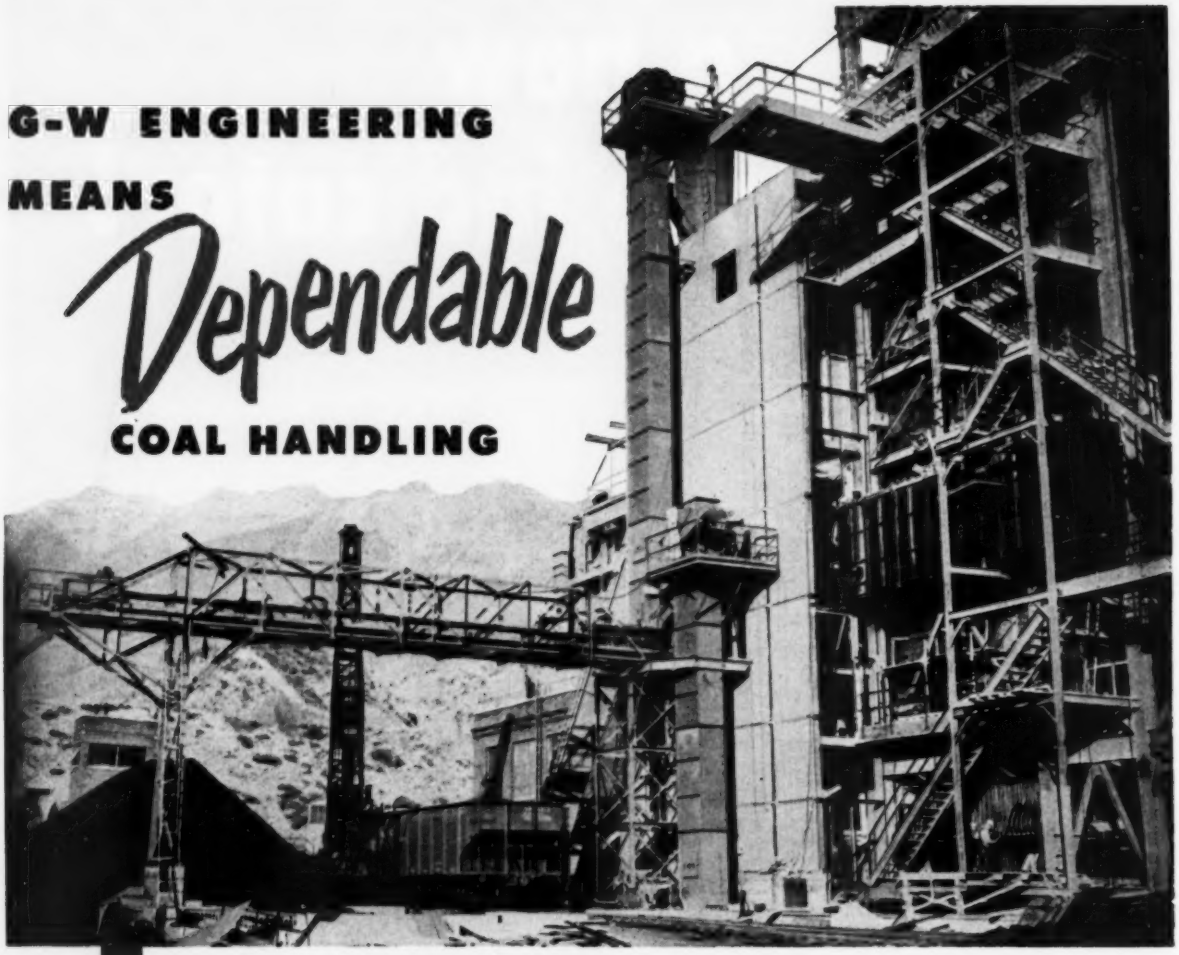

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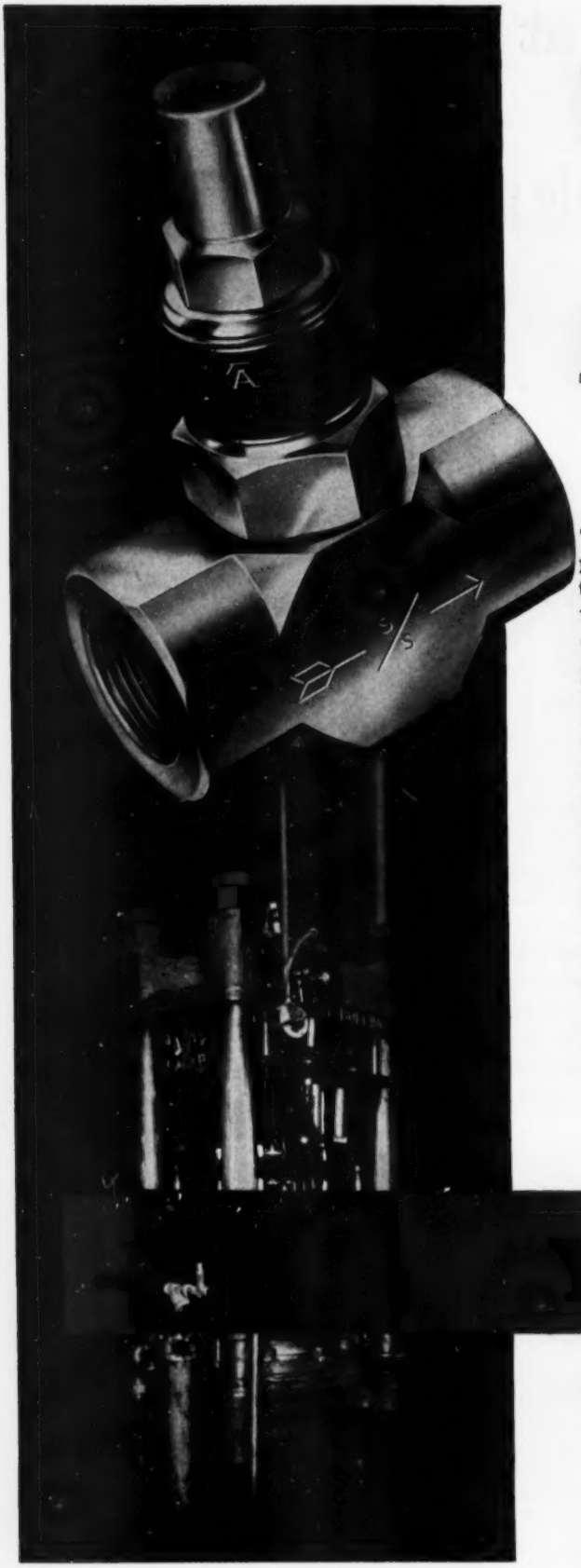

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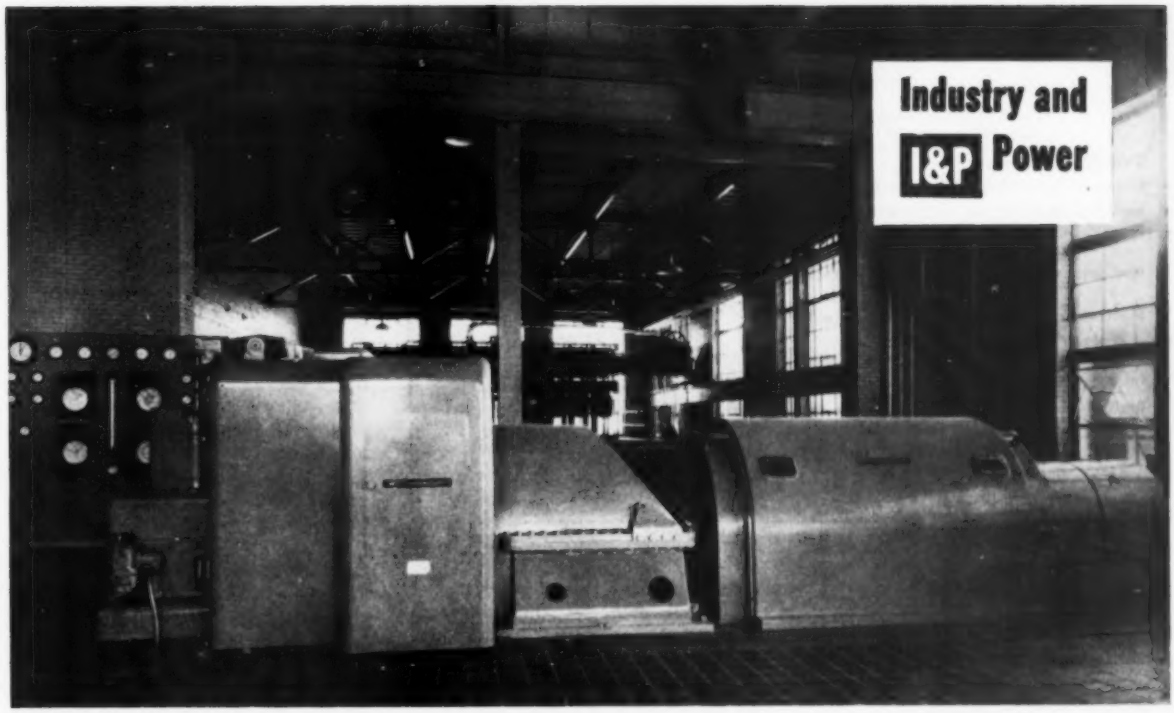


This 4000 kw turbine uses 400 psig 750 F TT steam. Unit has automatic extraction at 2 psig and uncontrolled bleed at 180 psig

Steam Turbine-Generators for Industrial Plants

Many factors must be considered when selecting power generating equipment. This article reviews fundamental steam turbine designs, discusses their application, and describes control systems for various operating cycles

S. D. FULTON
General Engineering Department
Steam Division
Westinghouse Electric Corporation

EIGHT BASIC TYPES of steam turbine-generators available for use in industrial plants and the services each can provide are summarized in Table 1. Most of these units offered by manufacturers today in industrial sizes are of the impulse design, as small ratings and increased pressures lead to small volumetric steam flows. The impulse turbine lends itself to these conditions with good efficiency because partial admission stages, which permit using favorable disc diameters and blade heights, can be employed. In the larger sizes, the impulse reaction design finds frequent usage, and condensing automatic single extraction turbines are being built in sizes as large as 40,000 kw.

Design Considerations

Generalization on selection of ratings and types of generating equipment is difficult because many factors, some of which are listed in Table 2, are involved. The most economical arrangement, of course, is to generate electric power as a by-product of the steam required for process operations because the heat in the exhaust or extracted steam is charged against production. However, the current high cost of power plant equipment and the relatively low cost of purchased power makes careful studies necessary to determine whether: (a) all electric power should be purchased, (b) power should be generated by noncondensing turbines serving as reducing valves for process steam with an electric utility tie line as a source of firm power, or (c) power should be generated by

TABLE 1 — TYPES OF INDUSTRIAL STEAM TURBINE-GENERATORS

Turbine-Generator Operating cycle	Process steam pressures controlled	Speed controlled
Straight condensing	none	yes
Condensing automatic single extraction	one	yes
Condensing automatic double extraction	two	yes
Noncondensing	none	yes
	one	no
Noncondensing automatic single extraction	one	yes
	two	no
Noncondensing automatic double extraction	two	yes
	three	no
Condensing extraction — induction	one (Note 1)	yes
Mixed pressure	Note 2	yes

Note 1—Steam is inducted if there is an excess of steam at the process pressure or is extracted if there is a deficiency.

Note 2—Inducts steam when pressure in turbine at induction point is lower than steam in line to which connected.

noncondensing and/or condensing extraction turbines with or without electric utility tie line. In some cases, a combination of turbine types may be used to obtain the best balance between steam and power demands.

Establishing Requirements

Naturally, the first step in the selection of steam and power generating equipment is to establish the requirements. Carroll (1) has indicated the necessary information includes: (a) electric power demand, (b) quantity, pressure, and temperature of all process steam demands, (c) balance between steam and power demands under various operating conditions, and (d) hot and cold water requirements. With these basic conditions available, steam conditions can be determined.

Selecting Steam Conditions

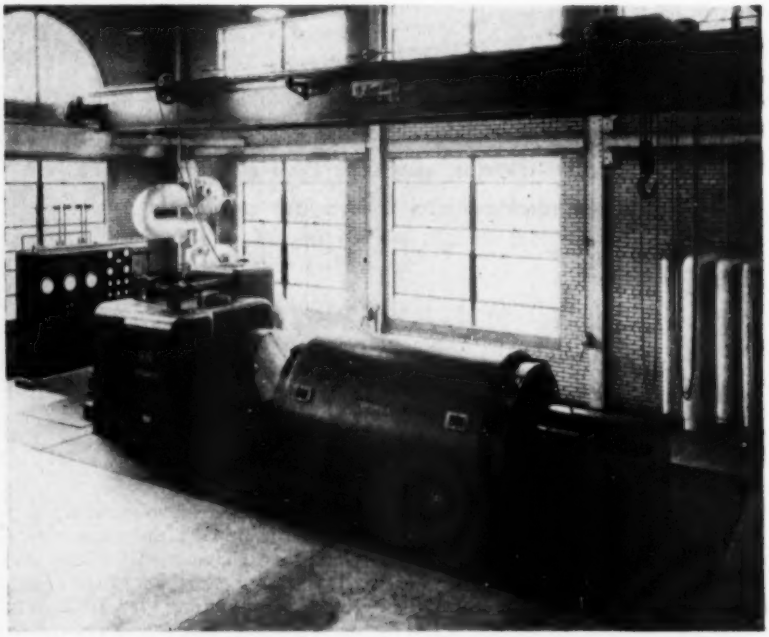
Experience with high pressure turbines in industrial plants (2) shows that the selection of steam conditions is dependent primarily on economics. Reliable equipment for pressures up to 1250 psig and 900 F TT is available even in small sizes. Water treatment suitable for even the higher temperatures and with high makeup have been developed. Temperatures at the turbine exhaust or extraction opening need not be a determining factor in the selection of steam conditions since a spray type desuperheater or a thoroughfare desuperheating heater (3) can reduce the temperature to or near saturation. Also, condensing processes can tolerate a considerable amount of superheat since the condensing temperature is determined by the condensing pressure and not the total temperature of the steam. With due consideration to all salient factors, the choice of steam conditions should then be one which will give the lowest over-all manufacturing costs and not necessarily those which will give the highest yield of electric power. The author (4) has prepared a monograph which facilitates a rough check of the fuel savings that can be obtained with improved initial steam conditions.

Selecting Equipment

For a given set of steam conditions, the next step in the selection of generating equipment will be to determine the approximate amount of by-product power which can be generated. Kramer (5) and Spahr (6) have given simple methods for this determination. Assuming that the by-product power is less than the demand, it must be decided whether firm power will be generated or purchased. With these things established a trial choice of generating equipment can be made. Several trials will be desirable to determine the most economical conditions.

It is obvious that raising the initial pressure and temperature will permit generation of more by-product power. Less obvious but equally true is the fact that a noncondensing turbine will produce specific quantities of electric power and process steam with upwards of five per cent less throttle flow than a condensing-extraction turbine. In specifying the extraction capacity of a turbine, care should be used to avoid specifying excess extraction capacity as this will impair turbine performance. When process pressures are close together, it may be more economical to extract at the higher pressure and use a reducing valve to get the lower pressure.

Nonautomatic extraction is not employed very often in industrial plants since the steam pressure is uncontrolled and hence not suitable for processes. However, an uncontrolled bleed point above an automatic extraction point may be used to supply steam for feedwater heating to obtain the gain in over-all thermal efficiency that results with higher feedwater temperature.



Steam supply for this noncondensing turbine-generator is 600 psig 750 F TT. Assembly provides process steam at 38 psig and has bleed point at 200 psig

When consideration is given to the thousands of combinations possible with different ratings, initial steam conditions, and extraction pressures, it becomes apparent that appreciable savings to purchasers could be made as a result of standardization (7). This is a subject worthy of study by the various technical associations.

TABLE 2 — FACTORS THAT INFLUENCE SELECTION OF GENERATING EQUIPMENT

1. Availability of adequate electric utility services and tie lines
2. Total cost of purchased power including demand charges
3. Cost of fuel and stability of fuel supply sources
4. Cost of various types of power generating equipment
5. Balance between steam and electric power demand at various loads
6. Limiting factors such as existing equipment or space restrictions
7. Availability and cost of cooling water
8. Construction costs including buildings where necessary
9. Desirability of spare capacity for standby purposes or load growth

Control Systems

The control system of any industrial turbine whose function is to supply process steam at controlled pressures as well as electric power is extremely important. In keeping with the importance of the duties to be performed, a fundamentally simple, yet sensitive and flexible completely hydraulic control system was developed for industrial turbines. This system proved so successful that it has been adopted for central station units.

Straight Condensing Control

Possibly, the simplest control application is straight condensing turbines, which require only speed control. For this operating cycle, the main oil pump, supplied with oil at a positive pressure of about 15 psig at the suction, furnishes oil at about 150 psig for lubrication and the control system including operation of the servomotor for positioning of the control valves.

Changes in speed cause the governor oil impeller to produce changes in oil pressure. A small quantity of oil from the main oil pump is supplied to the outer periphery of this impeller through a fixed orifice. This oil flows inwardly through the impeller and out to drain. Centrifugal force opposes the inward flow of oil and produces primary governing oil pressure that is exactly proportional to the square of the speed of rotation of the turbine.

The speed-responsive element and the initial governing force amplifier of the control system consists of a bellows to which is attached a spring and a cup valve. Changes in turbine speed produce proportional changes of primary governing oil pressure and the spring opposed bellows moves slightly. The action of the cup valve produces magnified changes in secondary governing oil pressure. These in turn are exactly proportional to the changes in speed. It is to these magnified pressure changes that the servomotor relay piston responds and actuates the cup valve which controls the oil pressure to one end of the servomotor relay. This controlled oil pressure force and an opposing spring serve to move the relay, which controls the position of the servomotor piston and the steam admission valves that regulate the input of energy into the turbine. The power operated relay is a unique feature of this type of control system.

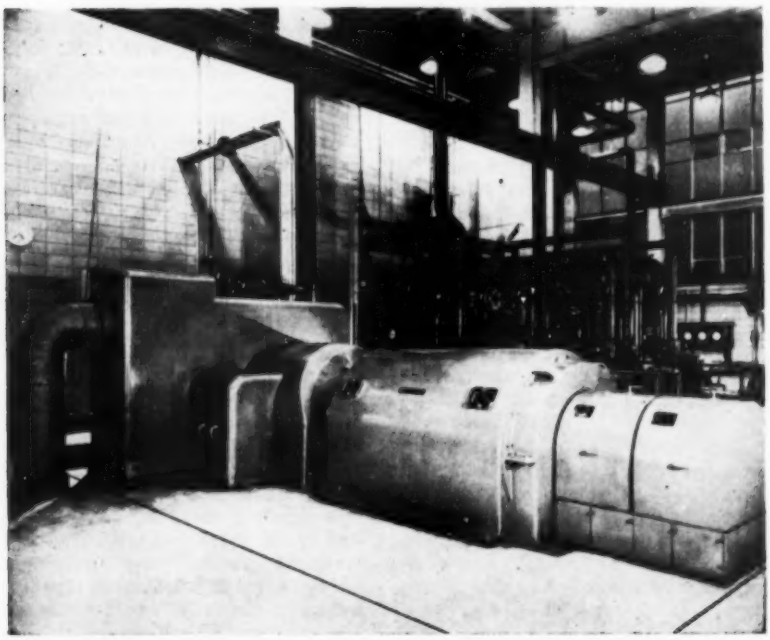
Governor Speed Compensator

In those industrial plants where close speed regulation is necessary and no tie with an electric utility exists, a compensated governor can be provided. Compensation provides transient normal regulation for stability and steady state close regulation to maintain frequency. It is possible to make the governor isochronous if desired. However, in this case consideration must be given to the governor characteristics of any turbine generators operating in parallel with a unit equipped with an isochronous governor.

Completely hydraulic control systems are virtually independent of oil viscosity since the governor impeller is a centrifugal pump operating at shut off; that is, it produces pressure without producing flow. Oil under positive pressure is delivered to the impeller, which is mounted on the turbine shaft, by means of an oil ejector that receives its motive oil from the pump discharge thus eliminating suction lift. This system has been used successfully for more than 25 years.

Safety Features

Various safety features are included with hydraulic control systems. For example, the turbine governing system, the overspeed trip actuated valve, and the throttle valve all are connected to the oil system to prevent operation of the unit without proper lubrication. Low operating oil pressure, low bearing oil pressure, and a hand tripping device also are connected to the oil



Noncondensing turbines find wide application in plants that require process steam. This 3000 kw unit reduces initial 590 psig 740 F TT steam to 115 psig

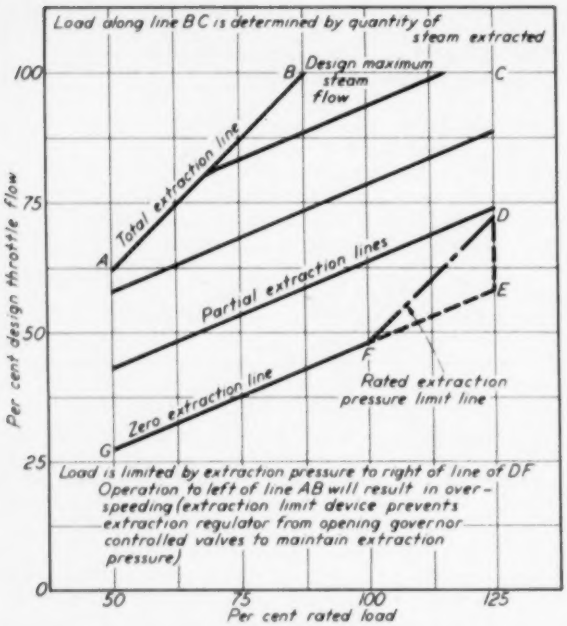
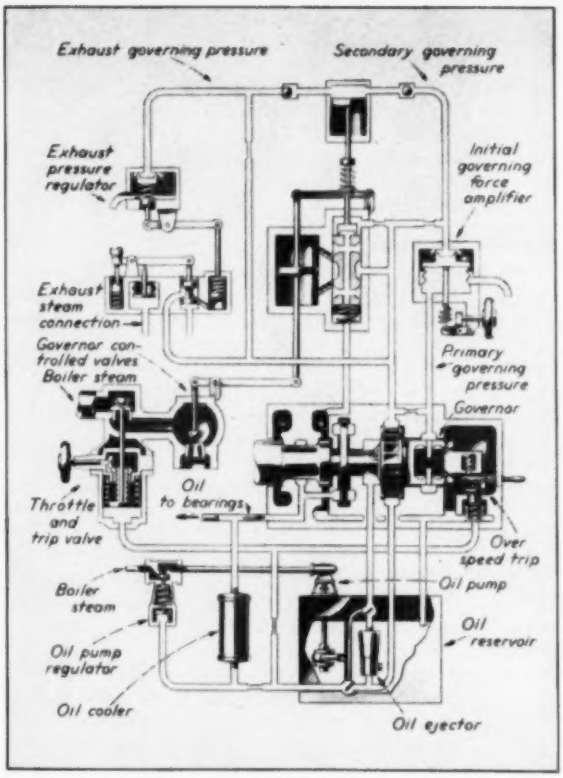


Fig. 1—Performance chart of single extraction turbine with compensated extraction regulator shows limits of operation



Schematic drawing at right illustrates the lubrication and control system for straight condensing turbine-generators

system. In addition, provision is made for instantaneously closing the control valves when the throttle valve is tripped, providing an additional source of protection against overspeeding. This is accomplished by impressing high oil pressure on the servomotor relay piston which has the same effect as a very large increase in speed.

Single Extraction Control

On automatic single extraction units, steam flow through the turbine is controlled by the steam admission valves and by an extraction valve. In general, grid valve type mechanisms are used for extraction pressures up to about 125 psig while steam chest type mechanisms are applied to higher extraction pressures. Each set of control valves is operated by a separate servomotor. To provide the desired control characteristics, it is essential that the actions of the components of the control system be coordinated so that the position of both sets of valves is adjusted appropriately and simultaneously to compensate for changes in operating demands imposed upon the unit. This is accomplished by arranging the servomotor relay pistons so that two controlled oil pressures are impressed upon both of them. One pressure is controlled by the speed of the unit. The other pressure is controlled by the extraction steam pressure, through the action of the extraction pressure regulator. In this combination of control components both servomotor relay pistons respond to the difference between the two oil pressure forces impressed upon them. Through their action, the steam control valves are positioned by speed, or the extraction pressure, or both.

Double Extraction Control

Turbines arranged for automatic double extraction require three groups of valves to regulate steam flow. Each unit has one grid valve type and one steam chest type or, in some cases, two steam chest type extraction mechanisms in addition to the steam admission valves. These valves must be positioned simultaneously to compensate for variations in electrical load or extraction steam quantities. Hydraulic interconnections coordinate the movements of all three sets of valves, and the result is precise control of extraction steam pressures and frequency or load.

Coordination in the control system is achieved by using servomotor relay pistons that are responsive to three oil pressures. One pressure is a measure of speed. The other two are proportional to the extraction steam pressures and are controlled by the pressure regulators. Thus, each of the three groups of steam control valves is positioned by speed and either or both of the extraction steam pressures.

In both single extraction and double extraction control systems, the extraction valves are instantaneously closed when the throttle valve is tripped, shutting off the flow of steam to the lower pressure stages of the turbine. This provides an added safety feature against overspeeding should an extraction line nonreturn valve fail to function. Since high pressure oil is impressed on the governor controlled valve relay piston and the extraction servomotor relay pistons are connected to it, they too will respond as to a large increase in speed and instantaneously close the extraction valves.

Fig. 1 illustrates a typical performance chart for an automatic single extraction turbine and defines the limits of operation. Consideration of these limits will aid in understanding the automatic extraction turbine.

Limits of Operation

When the electrical load on an extraction type turbine is lost due to circuit breaker tripping or the electrical load is insufficient to meet the extraction demand, the compensating feature of the extraction regulator could cause the governor valves to open to satisfy the extraction demand. For this condition, operation would be to the left of Line AB. This could cause overspeeding of the turbine unless restrained by electrical ties. The hydrau-

lic control system lends itself readily to prevention of this condition. A simple hydraulic connection from the extraction valve servomotor to the extraction regulator operating piston prevents the governor controlled valves from opening more than sufficient to satisfy the load demand. This is called an extraction limit device.

Operation along line BC occurs when the turbine reaches wide open governor control valve position. Then the amount of electrical load is determined by the extraction quantity required. A decrease in the quantity of steam extracted will cause a rise in pressure at the extraction opening and sensing this change in pressure, the extraction regulator will open the extraction valve to permit more steam to flow to the exhaust. This will result in more kilowatts being generated. With an increase in demand for steam, the pressure will fall and the extraction regulator will close the extraction valve, reducing the steam flow to the exhaust. Therefore, less kilowatts will be generated. For operation along the design steam flow line BC, the control has a preference for extraction demand.

When an extraction type turbine is equipped with compensated extraction regulator, the electrical load which can be carried is limited above rated load by the flow to the stages following the extraction valve. These stages are designed to give rated extraction pressure at rated load and zero extraction (extraction valve wide open). This condition exists to the right of line DF. When the load would require a flow to the stages following the extraction valve in excess of that which would give rated extraction pressure, the extraction pressure regulator will close the control valves to maintain the rated extraction pressure and consequently will not permit any increase in load. With a noncompensated extraction regulator, the extraction pressure will continue to rise until the load demand is satisfied or the control valves are wide open. This will be an unsatisfactory condition where accurately controlled process pressures are required.

Exhaust Pressure Control

If plant requirements permit, noncondensing turbines may be operated with a control system that automatically regulates the exhaust pressure. Then the quantity of power generated will be determined by the demand for exhaust steam. Supplemental electric power, to compensate for changes in operating requirements and also frequency control must be provided by other generating equipment.

Turbines provided with exhaust pressure regulators have the components of their control system arranged so that

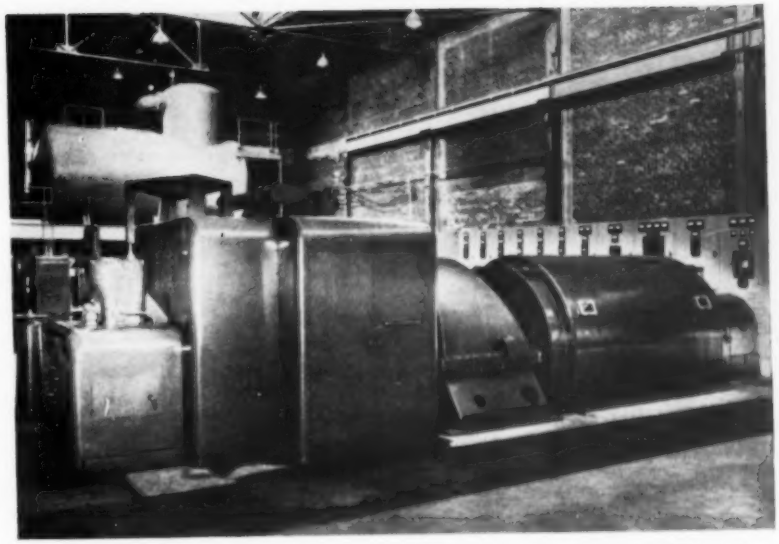


Photo shows 6000 kw condensing automatic double extraction (140 and 50 psig) unit designed for 580 psig 750 F TT inlet steam and 2 in. Hg abs back pressure

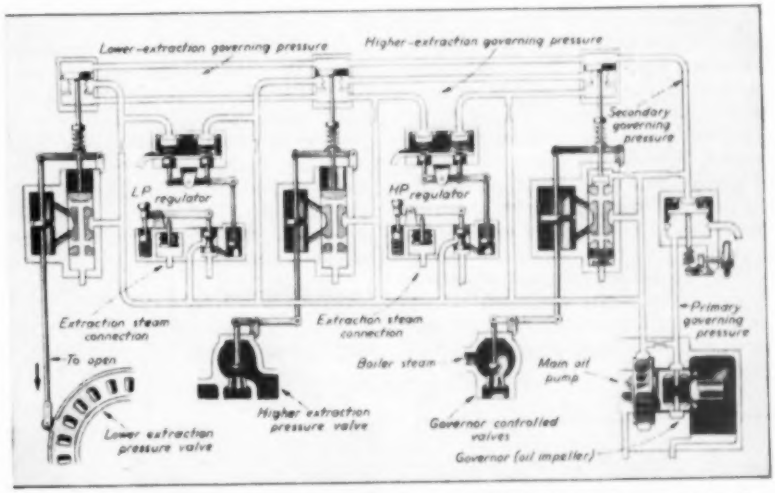
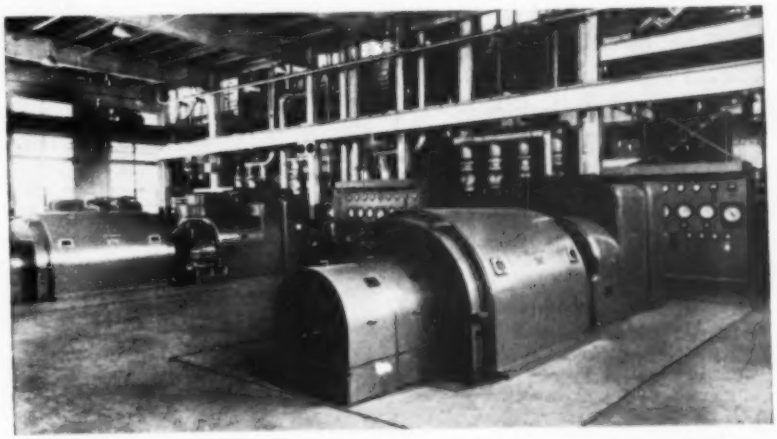
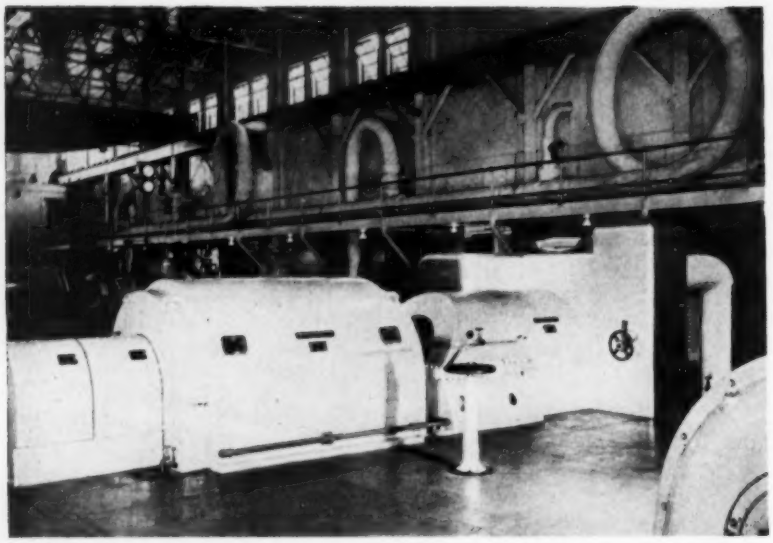


Diagram illustrates hydraulic control system, which includes three groups of valves to regulate steam flow, adapted for automatic double extraction units



In this plant, one noncondensing extraction (foreground) and two condensing extraction (background) turbines supply both 50 and 150 psig process steam



This 4000 kw condensing automatic single extraction turbine is designed for 400 psig 750 F TT steam, 2 in. Hg abs back pressure, and extraction at 6 psig

either of two alternate oil pressures is impressed upon the servomotor relay piston, depending on the desired method of operation. One of these pressures is a measure of exhaust steam pressure; the other of speed. By means of simple adjustment of the settings of the control system, it may be operated interchangeably in response to speed or to exhaust pressure.

With the exhaust pressure regulator in service, the steam admission valves are positioned in accordance with the demands for exhaust steam from the turbine and the pressure is regulated accurately. The exhaust pressure regulator may be applied readily to automatic single or double extraction noncondensing turbines. Thus two or three controlled steam pressures can be provided without speed (frequency) or load control. The load developed will depend on the steam demand at the various pressures.

Load Responsive Regulator

Where an industrial plant has a tie line with an electric utility for supplying part of the power requirements, it is often desirable to maintain a constant tie line load to minimize demand charges. The load responsive regulator serves this function. It can be connected in either of two ways to maintain the tie line load virtually constant: (a) to regulate load on the turbine-generator in response to plant load changes, or (b) to regulate load on the turbine-generator in response to tie line load changes.

In response to voltage and current variations, a static network provides power to actuate a solenoid which in turn applies a force to the main governor amplifier cup valve. This in turn varies the main governor secondary control pressure to satisfy the changes in electrical load. Since this device acts directly on the control system, the response is instantaneous and consequently maintains very close control on the tie line load. Another system, satisfactory for gradual load changes, operates the speed changer motor to compensate for changes in load.

Steam turbine-generators with sensitive and flexible control systems can be provided to meet any requirement in industrial plants. Careful selection of types, ratings, and initial steam conditions with due consideration of local service requirements will provide an economic source of electric power.

The material in this article was abstracted from a paper presented by the author at the Spring Meeting of the ASME held in Seattle, Washington during March 1952

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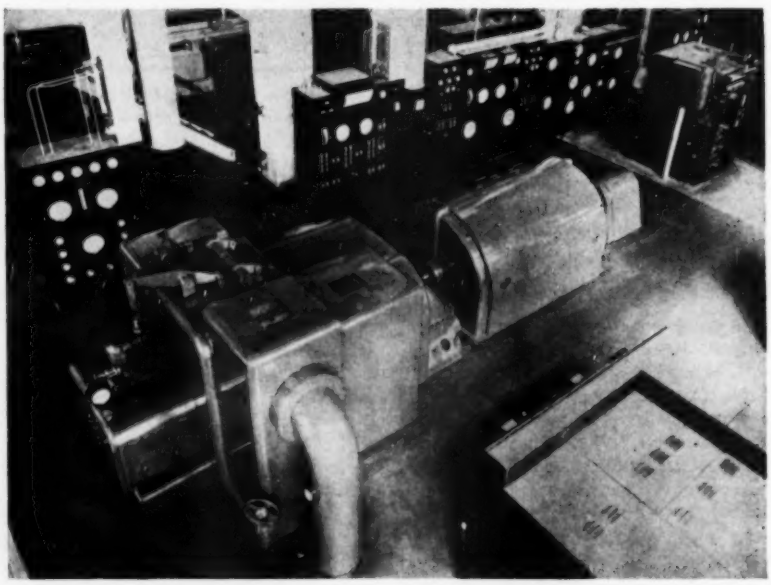
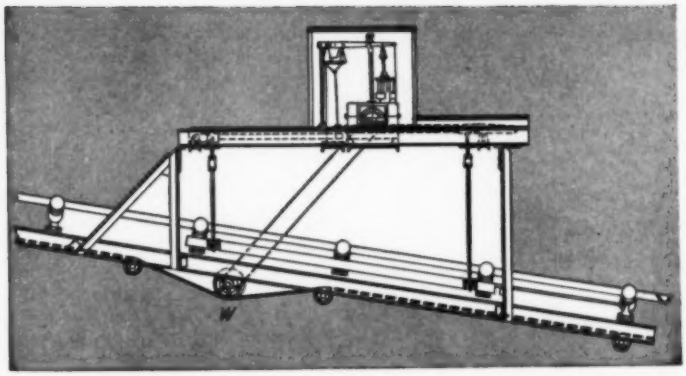


Typical installation photograph shows 5000 kw condensing automatic double extraction turbine and controls for steam and power generating equipment



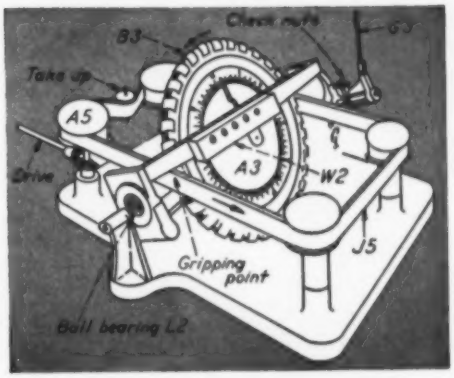


Fig. 1—Unit is adaptable for weighing either free-flowing or sluggish material carried on continuous belt conveyer. Weighing unit, located in penthouse, is pictured above to show the details of the complex actuating mechanism

How to Weigh Bulk Materials

Here are operating principles of several methods for automatically weighing bulk materials. These data will be helpful to those engineers responsible for the proper equipment selection

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BASIC FACTOR entering into selection of suitable equipment for automatic weighing of granular or pulverized materials in bulk is the range of flowability. A frequent selection for continuous automatic weighing of large tonnages is the *Weightometer*, Fig. 1. With a fairly steady feed rate it will record the weight of free-flowing or sluggish material carried on a belt conveyer to within 0.5 per cent of the true weight. Scheme of operation is quite simple. As shown, the weight beam is connected to a suspended section of the carrying run of the belt, and the integrating mechanism is driven by an idler pulley pressing against the return run of the belt, W. An integrating disc, A3, has crowned rollers, B3, carried in recesses around its periphery that are free to revolve on shafts tangential to the edge of the disc, but fixed endwise.

The disc-shaft is carried in ball bearings, L2, and is free to tilt under the pull of the weigh beam transmitted

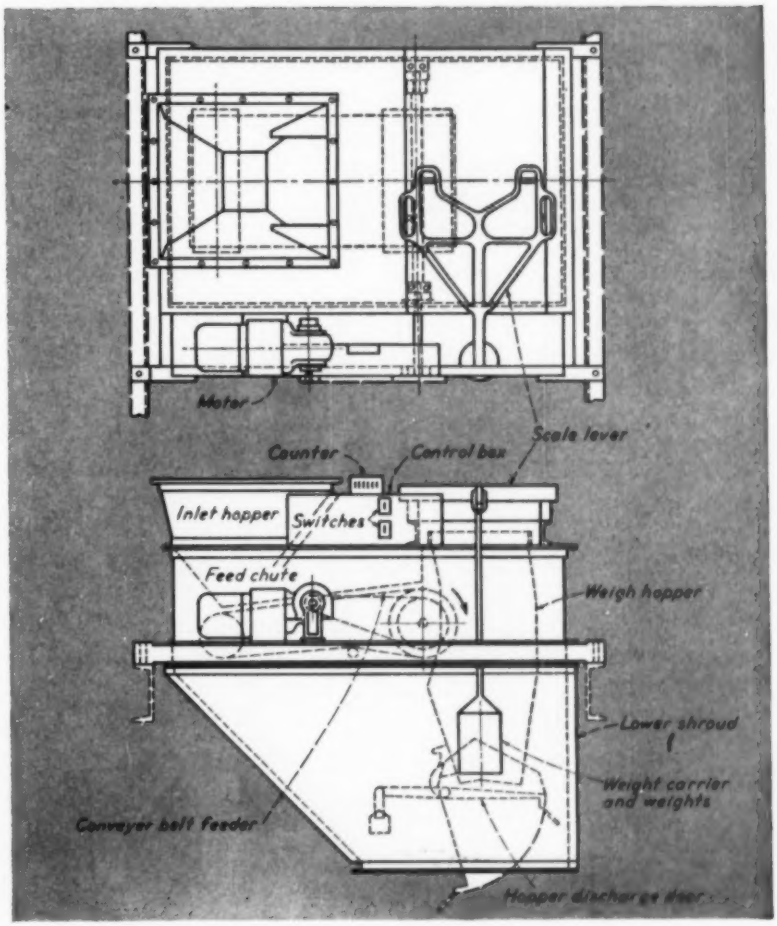


Fig. 2—Automatic batch weigher also serves as a feeder. The mechanism is equipped with a by-pass release, and belt feeder may be dropped in case of an outage

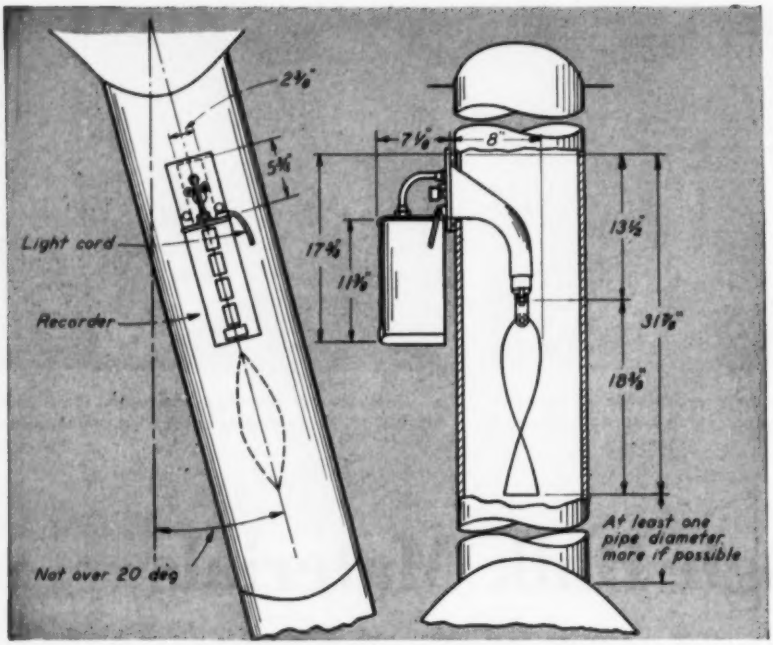


Fig. 3—Meters are usually applied vertically or nearly so in chutes leading from the bunker to stoker hoppers. Movement of coal turns blade in the duct

through G3. An endless belt, J5, is guided around a horizontal enclosing circuit by three idlers and a drive pulley, A5, and is pressed against the disc rollers at the two opposite gripping points as shown, Fig. 1, right. Drive pulley, A5, is driven from the return run of the conveyer belt, and the travel of belt, J5, is always in a fixed ratio to the travel of the conveyer belt.

As long as the rotation of the disc rollers, B3, is exactly in the plane of the integrator belt movement the disc will not turn. This is zero load position for an empty conveyer belt. When a conveyer load deflects the scale beam, and therefore tilts the disc, the rollers, B3, are skewed across the integrator belt and rotate the disc at a speed proportional to the tilt and consequently in proportion to the load on the conveyer belt. The rotation is a measure of the weight of material passing over the suspended section of the conveyer belt and, after calibration, the counter, W2, registers the total weight conveyed.

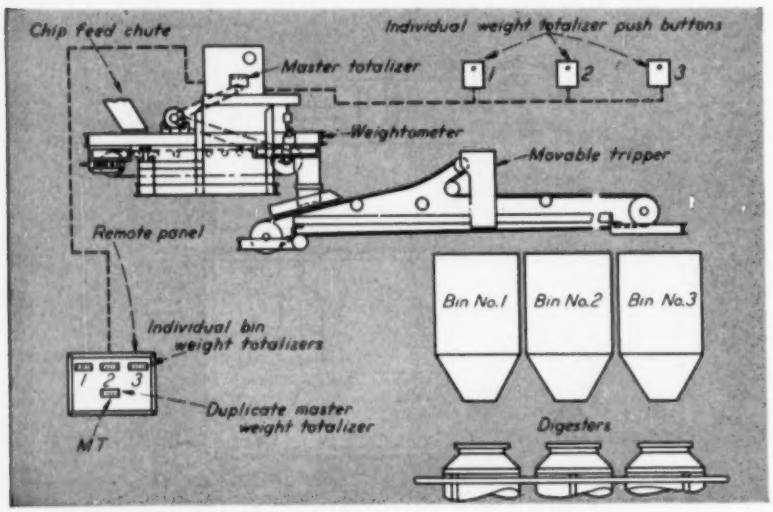


Fig. 4—Individual weight records are provided with arrangement for chips delivered to each bin and digester. Total weight of all chips is recorded separately

Calibration

Method of calibrating and subsequent testings is simple. A 20 ft length of roller chain of tested weight per foot is anchored on the weighing section. The length of belt passing this point multiplied by the chain weight per foot must correspond with the weight recorded.

This unit will weigh any material the conveyer can handle—from fines to lumps. When the material tends to adhere to the belt, an effective belt cleaner is essential. This is not always easy, especially with sticky material, as any residue comes back repeatedly over the weighing section and is registered as incoming weight.

On one recent installation handling washed anthracite buckwheat coal the weights recorded were substantially greater than the weight purchased. Inspection showed that the carrying face of the belt had a heavy adhesive deposit. Diagonal steel scrapers were substituted for the rotary cleaning brush beyond the head shaft, and the overweight was corrected.

Batch Weighers

Automatic batch weighers, Fig. 2, under average conditions have an accuracy to within 0.5 per cent. This machine fits in nicely for recording the rate of flow from a storage bin to a conveyer. It automatically controls the flow rate to suit the demand. Thus when the material backs up and does not clear the lower hopper, the weighing hopper discharge gate is prevented from opening, and the feeder belt remains at rest. This type of weigher has a range of from 200 to 800 lb per batch with a capacity up to 100 tph for materials that are free-flowing and containing lumps not larger than 3 in.

Where an accuracy of about 1½ per cent is satisfactory, and the material is granular or pulverized and free-flowing, a simple device costing about $300 as compared with $3000 for the batch weigher does a fairly good job. This has a section of helix within a chute, inclined not more than 20 deg from the vertical, geared to a revolution counter. This type of meter is shown in Fig. 3. As the mass flows down the chute it gives a fairly close record of the weight of material flowing past. It is essential that the chute be maintained full or the helix may spin. The readings are calibrated after installation. Of course, there is no control over rate of flow, and

its principal application is for weighing the flow of coal from a bunker to a stoker, which controls the rate of flow.

Fig. 4 shows a modification of the *Weightometer*, Fig. 1, for a special condition. A short center (10 or 12 ft) belt conveyer has a pivoted weighing section about 4 ft. long in the carrying run, suspended at one end by the rods, which actuate the tilt of the discs. The illustration shows its application for automatic discharge of a pre-determined weight of material to each of three bins. Fig. 5 shows a layout for automatically proportioning four different materials to a collector belt.

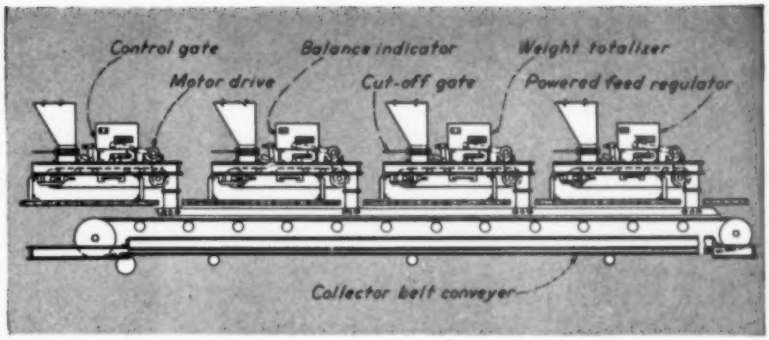


Fig. 5—Units in this setup proportion four materials to obtain a desired mix of product. Material drops upon belt conveyer and is carried to mixing bin

Feeder Weighers

Feeder weighers register the weight of material drawn from a bin to processing machines and they serve also as feeders so the material will flow always at a pre-determined rate—usually at a comparatively small rate. There are several devices available.

Fig. 6 is intended for granular or pulverized materials—usually bulk chemicals. A short pivoted belt draws the material from the bin or hopper at a rate controlled by a weighted lever, which opens or closes the hopper gate depending on the load on the belt. Rate of feed may be changed either by adjusting the counterweight or varying belt speed. The belt maintains a constant rate of delivery by weight, and a revolution counter records the number of feet the belt travels.

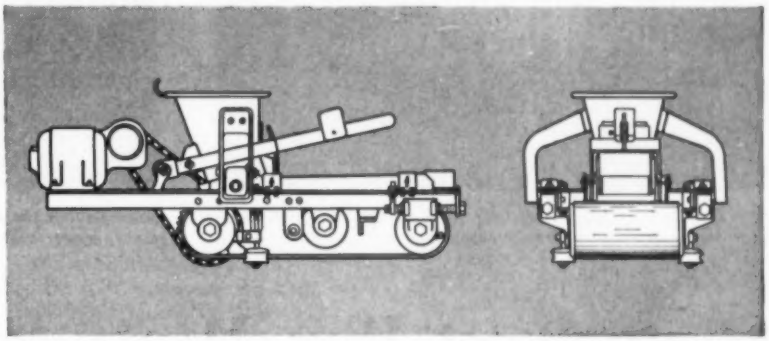


Fig. 6—Feeder weighers register the weight of material drawn from a bin to processing equipment and also serve as a feeder so the rate of flow is constant

Controlled Flow

Somewhat similar is the machine illustrated in Fig 7. A short pivoted belt is supported at the exact center of its length by a scale beam. As the beam rises or falls, it lowers or raises a gate controlling the flow to the belt. The setting of the scales fixes the volume of flow with only such variation of the load as result from irregularity or lack of homegeneity. An agitator operated by a crankshaft prevents clogging or arching in the hopper. However, if the material should hang up, the belt automatically stops and re-starts when the belt is normally loaded. A meter records the number of feet the belt travels, and this length multiplied by the weight at which the scale-beam has been set registers the pounds delivered. These machines have good accuracy and are intended primarily for the smaller capacities. One advantage is the low headroom required for the assembly.

Intentionally falsifying the recorded weight by tampering with the mechanism is difficult to prevent. The batch weigher, Fig. 2, does this by enclosing the unit in a dust tight housing, which also enhances the appearance. This is also a desired feature when the weigher is handling finely pulverized materials, particularly those dusts that are dangerous to inhale or are flammable.

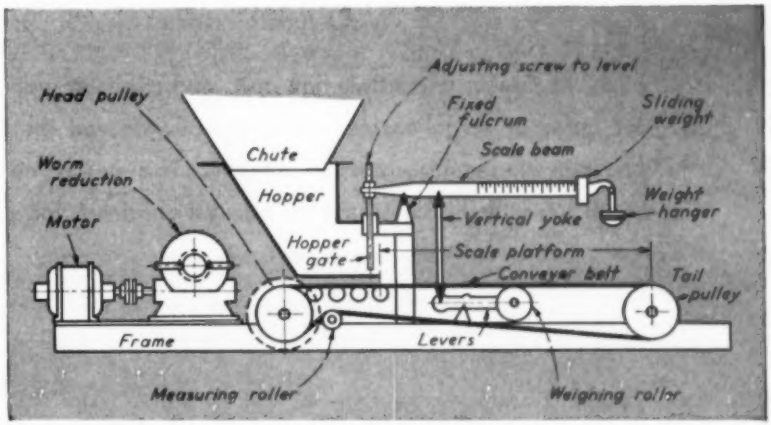
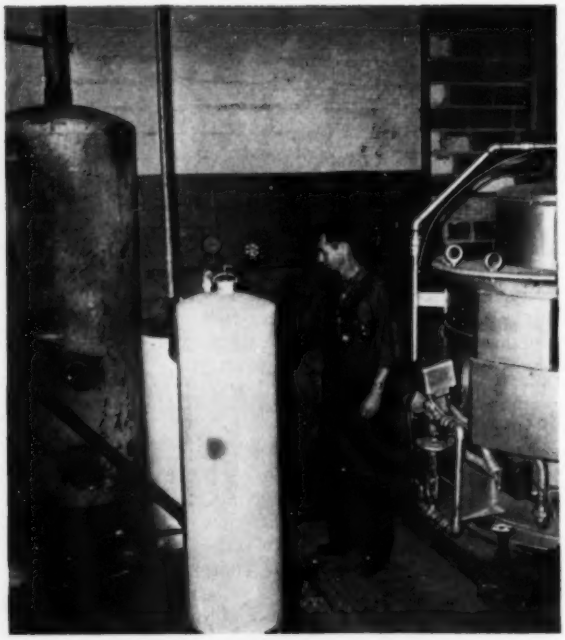


Fig. 7—This unit is applied for bulk materials where capacity is relatively small. An agitator operated by a crank shaft prevents clogging or arching in hopper

Where the tonnage is large, consideration must be given to moisture in the total recorded weight. Flowable coal may have 6 per cent surface moisture or more, and 2000 ton will be recorded as 2120 ton. At one large plant in northern Michigan, incoming coal contained as high as 15 per cent surface moisture, and it would not flow from the bunker in that state. A rotary dryer dries it to 6 per cent moisture by removing 5 tph of water. The dryer furnace uses about 1 tph of coal, or about 2½ per cent of the coal dried.

S. J. Jones, Plant Superintendent, inspects package generator that was installed to supply steam for the new corrugator



Area behind the boiler contains the natural gas connection, right, water softening system, center, and blowdown tank

South West Box Meets Added Demand with Package Steam Generator

High efficiency, low installation cost, and minimum operating labor requirements are some of the characteristics that have caused the extensive application of package steam generators in industry. This article covers the experiences of South West Box. Similar results can be obtained for other service conditions.

FRITZ THIEM, *Chief Engineer, The Hoerner Corporation*

DURING the past few years, many plants producing corrugated box board have increased output to the point that their boilers are straining to keep up with the steam demands. In some cases, the principal deficiency is steam capacity, while in others the existing boilers cannot develop the higher pressures required by modern corrugating machines. Both conditions have an adverse affect on production and frequently increase operating costs.

This situation is well known to The Hoerner Corporation of Keokuk, Iowa, which operates nine box board plants. Thus, when they installed a new corrugating machine at their South West Box Co. plant in Sand Springs, Oklahoma, they also obtained a package steam generator to supply the necessary steam. Old boilers in the plant were retained to provide additional capacity if the pressure dropped below predetermined limits and to generate supplemental heating steam.

Processing heavy Kraft paper into tough corrugated box board calls for a steady supply of constant pressure steam. For example, the new corrugating machine at South West Box Co. requires 175 psig pressure for processing 80,000 sq ft per hr and 195 psig pressure for outputs up to 100,000 sq ft per hr. These requirements are being satisfied by the package steam generator, which produces from 1000 to 5000 lb per hr of 99 per cent dry steam at pressures from 75 to 300 psig.

One of the important advantages of the new steam generator is its ability to produce ample high pressure, dry steam at the single face end of the machine. Here, adhesion must take place as the heavy corrugated paper makes contact at 500 linear fpm. The corrugating machine also requires steam for: (a) heating steam jacketed and corrugating cylinders, (b) keeping the ad-

hesive solution hot, (c) maintaining the temperature of the drying plates at 350 to 400 F, and (d) supplying small jets of live steam directly to the Kraft paper being processed.

Steam also is utilized for making starch glue, which is cooked in 660 gal batches. This is an exacting operation that must be performed carefully to assure the proper adhesive texture. A further use of process steam is the paraffin wax machine which produces a wax coating on cold storage butter cartons. Here, steam melts the paraffin and heats the steam jacketed rollers.

In addition to the process operations, steam is used to clean the corrugating machines. This daily preventive maintenance operation, performed after the second shift when the machine is shut down, uses high pressure steam jets, from three long hoses with ¾ in. nozzles, to remove all glue, trim, and grease from the corrugator. This system also can be utilized to clean other plant machinery before repairing or painting. Furthermore, the package boiler supplies steam for the unit heaters that heat the production areas.

Installation of the new steam generator was simplified by the fact that it is a complete package unit. All auxiliaries, including the feedwater pump, forced draft blower, fuel pump, and controls, were factory assembled. Only electric, fuel, and water service connections were required at the South West Box Co. when the unit was installed.

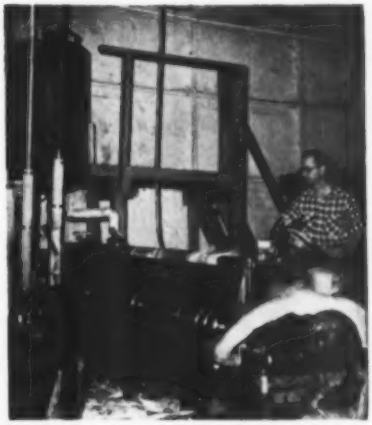
Although this particular plant burns natural gas, the steam generator can be fired by either gas or fuel oil. Transfer from one fuel to the other can be accomplished by a single adjustment of one control switch. Based on the present use of natural gas, the unit has averaged over 80 per cent efficiency and has reduced fuel costs materially when compared with the former steam generating plant.

In operation, the automatic controls are set to maintain any desired pressure within the design range of the generator. Once the operating pressure is established, the controls function automatically on an off and on cycle and modulate steam output to meet the steam demand. This arrangement is very satisfactory for the plant requirements as the unit can be shut down if production is suspended. When starting up, the generator develops 200 psig pressure in two minutes and can heat up all parts of the corrugating machine in less than an hour.

Careful condensate recovery from all possible process operations as well as the heating system increases the overall economy of the installation. The returns flow to a storage tank, which is connected to the suction of the feedwater pump. At this point, treated makeup that has passed through a water softening system is added at a rate of approximately 500 lb per hr. With this arrangement, the steam generator coils only require about a one minute blowdown every eight hours.

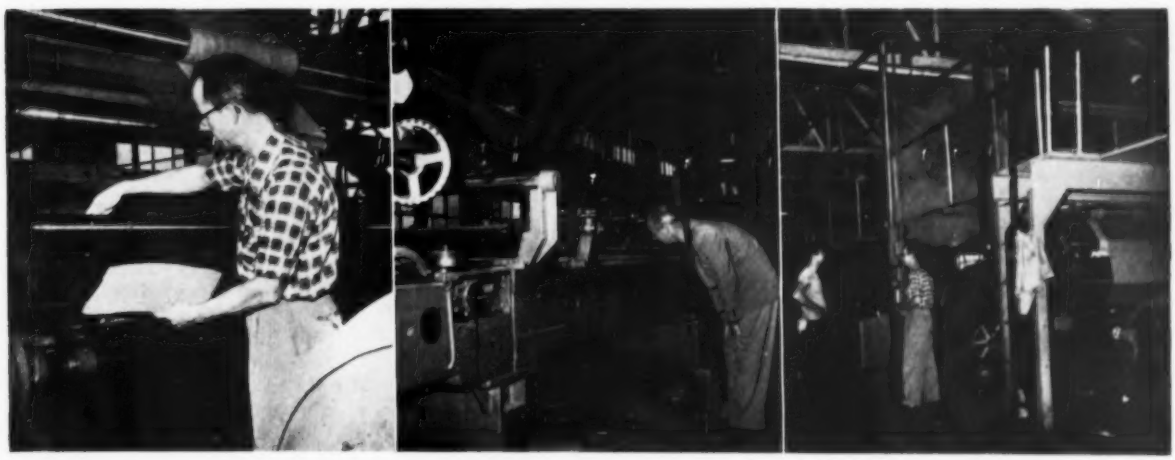
Since the steam generator is designed for fully automatic operation, labor requirements have been reduced to the minimum. However, many safety features are included in the control system to assure continuous satisfactory performance. These include an electric eye for flame failure protection, steam temperature limit controls, a time delay relay, and an exhaust gas temperature limit control.

Vapor Heating Corp. furnished the package steam generator for the installation described in this article. The water softening system was supplied by Elgin Softener Corp.



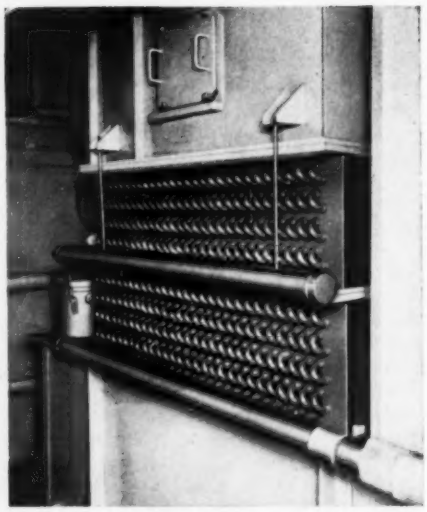
Steam melts the paraffin and heats the jacketed rollers on the coating machine

Live steam is directed into the vat of starch glue during the mixing operation



Corrugator produces 85 in. box board at a rate of 500 linear fpm. Unit uses steam for heating corrugating rollers, left, and maintaining drying plates at 350 to 400 F, center. Photo at right shows the central location of the automatic control panel

Thermostat located centrally on the outside wall of the drafting room controls the condition of the air. All air diffusers are located in ceiling



Humidity conditioner dehumidifies fresh air in summer and humidifies the air in winter

Cooper-Bessemer Expansion Includes

. . . year-'round air conditioning for the comfort of its employes. Moisture is controlled both in winter and summer by means of a humidity conditioner. Well water completes the cooling cycle

IN 1950, The Cooper-Bessemer Corp. completed the construction of a two-story 160 by 40 ft extension to their existing general office and engineering building in Mount Vernon, Ohio. With this building expansion, Cooper-Bessemer was faced with the same air heating and comfort cooling problem experienced by other companies who discovered original building facilities inadequate and resorted to adding a new wing. This most recent of the 130-year old firm's 30-odd structures was added to provide necessary offices and space for engineering and sales force.

How best to enlarge economically the air handling system then in operation was solved by this expanding organization in an apparently complex but highly practical manner. Cooper-Bessemer employes, who work on any of the three floors (first, second, and basement) in both the main building and the new extension, are provided with comfortable winter-and-summer air conditions. In accomplishing this, the company managed to salvage the best components of their old heating and cooling system, and at the same time incorporated a modern arrangement for the new wing.

In addition to conventional steam-heating equipment, Cooper-Bessemer had a small capacity chemical absorption-type dehumidifier that supplied conditioned air to the office space in the existing building. However, in renovating the old offices during the construction of the extension, management decided to relocate the large drafting room in the new wing. For complete office summer comfort, the existing dehumidification and cooling equipment was determined to be inadequate, both for the extension and the redesigned main building. For winter heating, it was felt that the existing gas-fired boiler was of sufficient capacity to handle both loads.

As a result, Cooper-Bessemer decided upon the equipment arrangement summarized in Table 1 to fulfill their winter heating and summer air conditioning needs.

Summer Operation

For summer operation, the goal for all offices was to maintain air conditions of 78 F and 45 per cent relative humidity (64 grains per lb), even when outside conditions are as high as 95 F and 118 grains per lb. However, the individual occupant in each room in the existing building has final control over the exact temperature condition in his office through the regulation of the room's combination cooling-and-heating unit. A total of 55 of these units are installed in the 47 rooms and the hallways on all three floors. The internal latent load in this building amounts to 121,030 Btu per hr.

Approximately 114 gpm of 57 F well water are used for the cooling cycle of this combination room equipment under maximum conditions. An additional 168 gpm of the well water, again under maximum operating conditions, are required for all other cooling in the complete air conditioning cycle for both buildings, except that necessary for the dehumidification unit. For the dehumidifier, 150 gpm of 65 F water is recirculated from the conventional aftercooling coils in both buildings and this amount is necessary to maintain dry air conditions. This figure, too, is for operation under peak load.

The dehumidifier unit handles 10,000 cfm of fresh air, delivering 5000 cfm at 41 grains per lb direct to an aftercooling coil in the existing building system. In the aftercooling coil, the air temperature is lowered as required to maintain the desired room conditions. This fresh

Heating system includes baseboard radiation and circulated heated air

TABLE I — EQUIPMENT SPECIFICATIONS

Building	Fresh air requirements		Recirculated air requirements	
	Summer	Winter	Summer	Winter
Existing	12,500 cfm air capacity humidity conditioner* with separate air filter and aftercooling coil	Preheat and afterheat coils combined with humidification unit and filter	Individual room cooling-and-heating units using 57 F well water for cooling	Individual room units using steam for heating
New Wing	Same as above, except that 4 aftercooling coils are required, one for each zone in new wing	Same as above, except 4 reheat coils are required for each zonal control	4 cooling coils, one for each zone to handle mixture of recirculated and fresh air	4 afterheat coils using steam, one for each zone to handle recirculated-fresh air mixture

Natural gas-fired boiler supplies steam for all operations. 6000 cfm air capacity exhaust fan common to entire system.

*Kathabar—Supplied by Surface Combustion Corp.

Shell-and-tube hot water converter operating on steam supply to heat water for baseboard radiation system in new wing

air supply is delivered via ductwork in the building hallways directly to individual room diffuser. With peak summer fresh air conditions, the humidity conditioner removes approximately 1420 gal of water from the total 10,000 cfm of outside air in a 24 hr period.

Another 5000 cfm of fresh air is supplied to the air conditioning system for the new extension. This conditioned air, leaving the dehumidifier with a moisture content of 41 grains per lb, is mixed with 12,450 cfm of air recirculated from the new wing. By reason of the mixing action, the air moisture content is raised to the final delivery condition of 49 grains per lb. Such an absolute humidity level as this is capable of caring for the internal latent load of 62,870 Btu per hr in the wing.

Mixture of fresh and recirculated air passes over cooling coils in each of 4 zones for final temperature control. One zone, the basement, contains 83,200 cu ft and has a maximum occupancy of 30 people. The second zone, of 89,600 cu ft, is located in the second floor and has as many as 70 occupants. The third and fourth zones are located in the north and south offices on the first floor. These offices have a combined volume equal to that of the basement and have a maximum occupancy of 52 people.

Winter Heating

Cooper-Bessemer's winter heating plant maintains a 70 F temperature throughout, even when outside conditions are as low as 0 F. Occupants in the existing building have final control over their office temperature by means of the individual room units. These units operate on 15 psig steam.

Total heating load for this building is 1,029,300 Btu per hr. The 56 hp natural gas-fired boiler introduces steam directly into the existing piping system in the main building to supply the room units, which operate on recirculated air exclusively. The preheat coil on the total fresh air supply heats the air to 45 F when the outside air temperature falls below this level. After passing through the humidification unit for humidifying purposes, the fresh air supply to the main building is finally tempered by reheat coils. Both the preheat and reheat coils operate on the 15 psig steam.

Baseboard Radiation System

To care for part of the 840,250 Btu per hr heating load in the new extension, the mixture of humidified fresh air and the untreated recirculated air are tempered by reheat coils in each zone. However, to compensate for the lack of individual room units in the wing, a radiation baseboard heating system has been installed. A hot water converter operating on 5 psig steam heats the water circulating in baseboard piping.

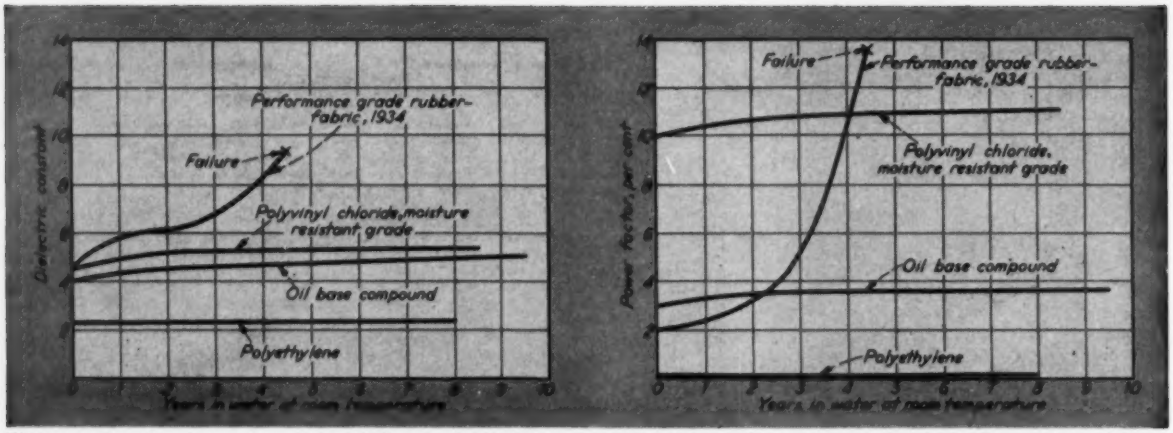
Radiation piping is divided into six zones, one for the north and south wall of each of the three floors. Each zone's hot water supply is individually controlled in inverse proportion to the outside temperature. The lines extend lengthwise of the wing, converge at the west center end of each floor, and have a common hot water return to the heat exchanger and pump.

Heart of this entire air conditioning system, the humidity conditioner, consists of two separate pieces of equipment, an air washer and a regenerator. Air to be conditioned passes through the air washer, making contact with a lithium chloride-base absorbing solution. The absorbent removes or adds moisture in selective amounts dependent upon its temperature. The cooler the solution, the more moisture absorbed.

Both air and absorbent pass over cooling coils within the air washer, these coils controlling the absorbent temperature, while the 65 F recirculated well water is the cooling medium. Automatic controls govern the rate of flow of the cooling medium, and this in turn regulates the amount of air drying accomplished.

Intermittently, as the absorbent becomes moisture-laden, a small quantity passes into the regenerator and makes contact with steam coils. As the solution temperature is increased, it loses its excess moisture, and a scavenging air stream is utilized to exhaust the unwanted water to the outdoors. This action maintains the absorbent at a constant specific gravity so as to retain the solution's moisture-holding capacity.

A maximum of 1700 lb per hr of 5 psig steam is required for this absorbent-regenerating action under peak operating conditions. Operation of this equipment is continuous and entirely automatic. No manual control is required. Since the dewpoint of the air leaving the unit is below the temperature of the well water circulating in the cooling coils, no moisture condenses on these coils and this assures a dry and easily maintained equipment. Lastly, the antiseptic nature of the absorbent tends to sterilize the air and this feature provides comfortable air conditions



These graphs show some long time, 1000 c test results on typical insulations. Time consumed retards development of new types. The text explains limitations of accelerated tests and how interpretation is affected by application

What Moisture Resistance Means in Cable Insulation

You may need power and communications cables with high moisture resistance, but don't depend on absorption data to tell the whole story. Here is a description of how tests are made, what they mean, why other factors must be considered in special applications, and why manufacturers' recommendations should be followed for the more common types of installations

R. C. GRAHAM, *Chief Engineer, Rome Cable Corporation*

ANY CABLE DESIGN with a continuous metallic covering, such as lead sheath, automatically provides complete moisture protection to the underlying insulation except when a discontinuity or rupture inadvertently appears. But a metallic sheath is not always advisable or practicable because added weight, electrolysis, corrosion, vibration and economic factors may eliminate its usefulness as a cable covering. This condition seems to be more the rule than the exception and consequently ability of conductor insulations and non-metallic coverings to withstand water or moisture can well become a major concern.

This means that a knowledge of possible effects of moisture is needed. Theories or mechanics of moisture attack, methods of test, evaluation of insulating materials and coverings, effects of environmental conditions, and the like, should all be considered.

History

Need for flexible and moisture resistant insulation was first met for submarine telegraph cable some 40 yr before its use for power cable in this country. Faraday used gutta percha insulation in his experiments about 120 years ago. The first submarine cables across the English Channel, made in 1850, were insulated with it and it is still commonly used for submarine communication cables. But at shore ends where exposed to air, gutta percha softens and oxidizes readily.

The peculiar problem of moisture resistance was therefore met and recognized early in communication cable development. Gutta percha hod excellent stability of electrical properties when wet, but deteriorated when allowed to become dry. Vulcanized rubber had good mechanical properties, resistance to temperatures of tropical water in that it did not soften, could be exposed to air and was relatively resistant to oxidation. However, electrical properties in water were relatively unstable. At shore ends where gutta percha was least satisfactory, replacement was less of a problem and rubber was an excellent supplement.

Through cooperation of the Coast Guard, Bureau of Standards and cable manufacturers, studies were carried to a successful conclusion, and in the mid 1920's a specification was developed. This included a gravimetric test for water absorbed and a test for change in dielectric constant at 1000 c after a few weeks water immersion at 70 C. It was designed to select a high rubber content

insulation suitable for communication service and, with few modifications, is still used today.

In the late 20's, there began a trend away from lead sheaths for power cable, emphasizing moisture resistance of rubber for power use. Except for the Coast Guard study and similar investigations it was almost impossible to predict performance of the many insulating materials then available without actually utilizing them in service. While this involved almost prohibitive time, it did show that:

1. Results of long time unaccelerated immersion tests in the laboratory paralleled the long time performance properties.

2. Ability to operate successfully over long periods in wet locations was directly related to the stability of electrical characteristics for the same periods and under the same conditions in the laboratory.

Subsequent experience has proved this reasoning to be correct, whether applied to communication or power cables and regardless of the type of insulation involved. The remarkably successful performance of most of the nonmetallic sheathed power cables used underground and under water are dependent almost wholly on ability of the cable insulation to maintain its initial physical and electrical properties for long periods in the presence of water.

Theories

It is generally agreed that there are at least two physical methods by which water might affect insulation:

1. Absorption is a direct layer effect where the successive outer layers of the insulation might gradually become water soaked. This would be reflected by tests for increase in weight or electrostatic capacitance of the dielectric.

2. Diffusion is more complex with additional parameters such as pressure and rate, where moisture might permeate the insulation and establish possible irregular conducting paths of water from the conductor to the outer surface. A weight test would not disclose such a condition but it is believed that some sensitive electrical quantity such as insulation power factor or resistivity is related to it.

Effect of moisture upon cable characteristics can probably be best explained by electrical action, since it is a direct determination. The insulating properties of a dielectric are adversely affected by the conducting properties of the water.

The equivalent electrical circuit of a cable dielectric is that of an imperfect condenser. Under an alternating stress, the total excitation current is the vector sum of charging and leakage currents.

An increase in charging current results from an increase in capacity (or apparent dielectric constant). An increase in leakage current results from increased conductance, G. A change in either, of course, changes power factor. Water would increase either or both current vectors, and the ultimate effect is increased capacity and, particularly, power factor of the dielectric. This effect has a direct bearing on electrical life and performance characteristics of the cable insulation.

Electrical Stability

Determining feature for any insulation operating under an a-c stress is its electrical stability. As soon as insulation strength becomes erratic under a particular set of circuit conditions, its usefulness to that circuit is terminated.

For a power cable, the point of complete electrical instability is reached when increased dielectric losses permit actual thermal failure of the insulation (under normal conditions). For a communication cable this point is reached when attenuation constants increase so that an acceptable quality of communications or signalling cannot be maintained.

Absorbed moisture reduces surge and normal frequency breakdown strength. Therefore, the ultimate criterion is effect on electrical stability of the cable—all other effects being secondary. The longer the electrical properties of the conductor insulation remain relatively constant in presence of water, the better the true moisture resistance.

Test Methods

While long time tests have proven fundamental and helpful in adding to our knowledge, something of a more practical nature has been needed. Several short time test methods based upon either gravimetric methods or changes in electrostatic capacitance (usually at 1000 c) have been proposed and investigated. The accelerating influence was generally water temperature. For some materials, these tests provided a relatively truthful index of moisture resistance, but for certain other materials a completely false indication of true performance was obtained. In service in wet locations, oil base, ozone resistant insulations have shown excellent stability. But accelerated tests at high temperatures gave completely misleading results, whereas slightly lower test temperatures provided a more reliable indication. The early heat resistant, super aging natural rubber compounds had poor moisture resistance as based on service records. Yet short time, high temperature accelerated tests usually indicated very good moisture resistant qualities.

Accelerated Tests

The need for short time tests has been great and there has been considerable progress. Temperature of the water bath has substantial accelerating influence, although caution is needed in establishing a maximum test temperature that will not alter results because of chemical or physical changes. For most materials, 50 C has been found satisfactory.

Further, effects of insulation thickness are reflected in the rate of change in electrical properties. Thus, thin walls (preferably not less than 1/32 in.) of a given material on a conductor will disclose the effects of water much sooner than heavier coverings.

An increase in the applied test voltage will generally cause a truthful "acceleration." For example, measurements of power factor and capacitance at 60 c voltages up to 80 v per mil provide reliable tests for insulated conductors for 60 c power service.

In fairly recent action, ASTM and IPCEA have established standard mois-

About This Article . . .

As the number and types of applications for electrical circuits increase and as reliability of power supply, control and communication becomes more critical in industrial plants, selection of cables and engineering of the installation become more important. Manufacturers have, and are still, developing many types and can supply one or more that will be highly satisfactory for most applications.

One of the major problems often met is installation in moist, wet, buried or chemically active installations. In these cases moisture resistance is very important. However, moisture may affect cable operation in several ways, and each may be more important in some applications than in others.

While the engineer is primarily interested in test results in the form of recommendations, it is often easier to apply them intelligently if meaning and implications of the tests are understood. Consequently, this article was selected partly because it discusses moisture resistance in various applications, and partly because it also describes development of the tests, giving limitations as well as advantages, in a highly interesting manner. Unfortunately, space does not permit similar analysis of other deteriorating factors which may also affect selection.

ture absorption tests as follows:

1. A gravimetric method for increase in weight of a specimen immersed in water at 70 C for seven days. This test discloses weight of water an insulation will absorb but not where and how it is dispersed. The distribution affects electrical stability and can be evaluated only by an electrical test. For many materials whose electrical behavior in water is known, this may prove to be a useful control check, but the value for comparing different materials is doubtful.

2. An electrical test of 1000 c capacitance of cable specimens immersed in water at 50 C for two weeks. This, plus the gravimetric method, is recommended by IPCEA for communication cables.

3. An electrical test on 60 c capacitance and power factor at 40 and 80 v per mil on cable specimens immersed in water at 50 C for two weeks. Sometimes called the Stability Test, it is the only one recommended by IPCEA for power and control cables.

While these tests seem a good guide to selection of insulation for wet locations for power and voice frequency applications, there are limitations. Even more reliable criteria will be needed for the ever increasing number of newer insulating materials and are under continuous and vigorous study.

An investigation of insulations suitable for d-c operation (signal and control cables) in wet locations is also under way. Direct current introduces electro-osmosis, similar to osmotic pressure. It is directional in effect, dependent on charge on the conductor, and on chemical composition of the insulation as well as the surrounding water. Thus far it appears that insulations such as polyethylene which are the most stable electrically also are best for d-c operation. However, all insulations suitable for a-c operation are not all satisfactory for d-c.

Capacitance changes at radio frequencies are substantially equivalent to moisture absorption effects at 1000 c, but insulation power factor measured at radio frequencies might easily rise to prohibitive values as compared with negligible power factor changes at 1000 c. Wet or even humid conditions might lead to surface leakage, otherwise satisfactory, causing considerable difficulty on high frequency wiring.

TABLE 1 — MOISTURE RESISTANCE OF INSULATIONS AT LOW FREQUENCIES

Thermoplastic	
Polyethylene	excellent
Polyvinyl chloride	good
Ethyl cellulose	fair
Nylon	fair
Teflon	excellent
Kel-F	excellent
Polyfluorinated ethylene	excellent
Thermosetting	
Submarine rubber compounds	very good
Ozone resistant compounds	very good
Performance grade	fair to good
Code grade	poor

TABLE 2 — MOISTURE RESISTANCE OF SHEATH OR CABLE COVERINGS

Polyethylene	excellent
Polyvinyl chloride	very good
Rubber or GR-S jacket compounds	good
Polychloroprene	fair
Fabric coverings	good

Stabilization

For any geometrical configuration other than a round, single conductor, insulated wire, difference between wet and dry exposure might substantially decrease electrical efficiency due to "electrode" effect of the presence of water — regardless of moisture resistance of the insulation.

Mutual capacitance of a conventional twisted pair telephone wire immersed in water is nearly twice that of the same pair suspended in free air. This means effective talking range is correspondingly reduced since attenuation losses are directly proportional to the mutual capacitance.

Such effects, being independent of the moisture resistant properties of the dielectric, can only be corrected by cable design—called stabilization. An overall electrostatic shield would stabilize so that there would be negligible difference between wet and dry talking range. A high degree of stabilization could also be obtained by a non-metallic sheath.

Shielding for stable operation in voice frequency communication cables is fairly standard. It may consist of metallic tapes or braids, semi-conducting layers, or a combination. Of course, this also provides reduction of interference and cross talk, protection from lightning and other voltage surges, and the like.

On higher frequency circuits, the problem may not be as easily solved. Surface wetting not only increases mutual capacitance and attenuation, but characteristic impedance of the line is also affected so reflection losses due to impedance mismatch further decrease efficiency. For these cases, careful design is required.

Test Results

The graphs at the beginning of this article show long time test results (1000 c capacitance and power factor) on some typical insulating materials. The excellent stability of polyethylene is significant since it is ideally suited for communication cables because of low dielectric losses.

A brief summary of the moisture resistance of cable insulating material for low frequency applications is given in Table 1. For higher frequency applications, polyethylene and the fluorinated ethylenes are considered preferable. For d-c applications, polyethylne seems to be the best. Most polyvinyl chloride compounds are poor, although a satisfactory compound can be achieved. Of the thermosetting materials, the submarine and ozone resistant compounds are preferable. Moisture resistance of conventional sheath or cable coverings may be classified as in Table 2.

It is always considered good design practice not to rely on the sheath for moisture protection but to obtain the highest degree possible in the insulation itself. There is always danger in too broad an interpretation of data. Many materials having ideal moisture resistant characteristics may be, and often are, actually inferior to materials less stable in the presence of moisture but more stable for other operational conditions and hazards.

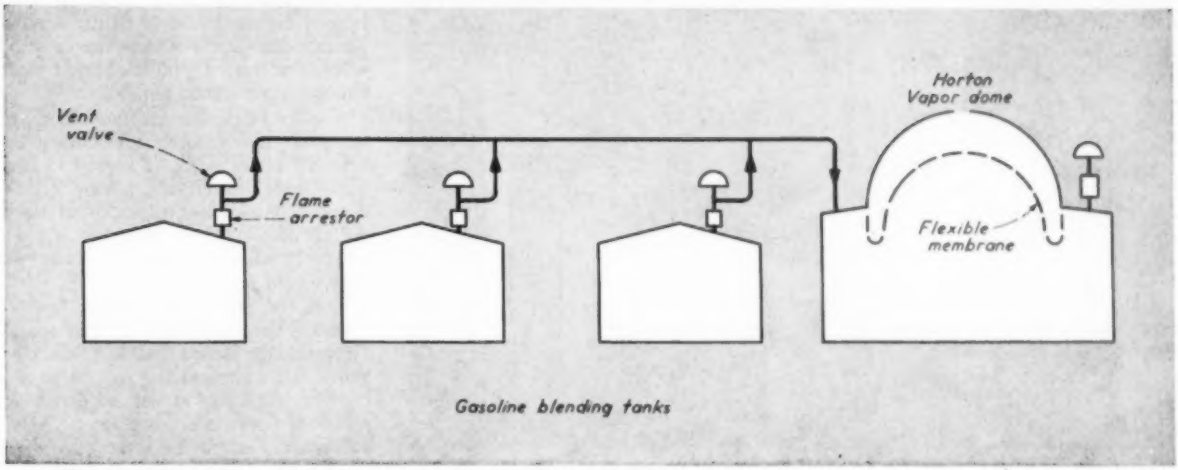
Summary

Insulating materials with such superior moisture resisting properties that water is no longer considered a serious hazard to cable operation are available. Not only have new insulating materials helped this, but development of suitable laboratory test methods to correctly evaluate moisture resistance has also been a necessary contribution.

Because of the various possible effects of moisture on insulation, the end use should be analyzed carefully before selecting materials and design. In any event, it should no longer be mandatory to specify a lead sheathed cable design for wet locations. There is no question but that we are headed for still better moisture resistant insulations and towards better tools for a more intelligent understanding of the problem.

DON'T CLIP—DON'T TEAR
WRITE FOR TEAR SHEETS!

Rather than spoil this issue for other readers in your plant, let us supply you with copies or tear sheets of any of the articles for your files. Just drop a line to the editors, preferably on company letterhead, for articles desired.

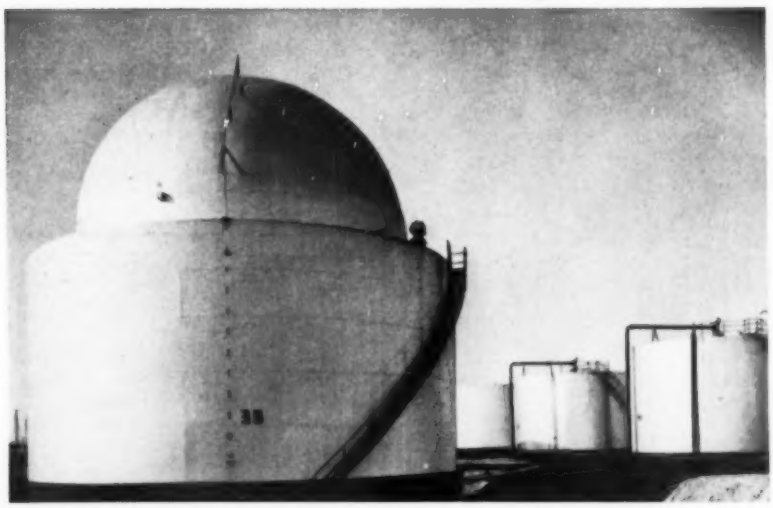


Vapors from the gasoline-blending tanks are recovered in a Hortondome system

Waste Disposal in Urban Areas

Here are waste treatment experiences Aurora Gasoline Co. encountered to provide the minimum of annoyance to persons living adjacent to their metropolitan refinery plant. Sulfur vapors were burned, flue gases were neutralized, and waste water was treated before discharge

FRANCIS C. MORIARTY and MAX M. FISHER
Aurora Gasoline Company



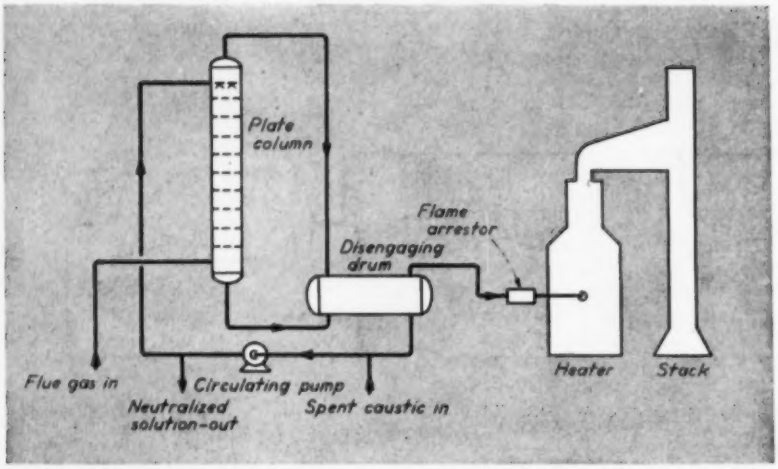
Flexible membrane in Hortondome, in foreground, provides a compensating volume to receive or discharge the vapors displaced in the blending operations

AURORA GASOLINE COMPANY's refinery is located within the city limits of Detroit immediately adjacent to a relatively congested residential district. Yet, the plant meets the full compliance of the municipal ordinances. Furthermore, it has required the maintenance of the minimum of noxious waste disposals to avoid neighborhood complaints, with their almost irreparable harm to public relations.

Waste materials fall naturally into three general classifications: solid, liquid, and gaseous. The handling of each encompasses two phases: first, the steps taken to reduce or eliminate their volume, or to eliminate them completely, and, second, the ultimate disposal method available.

Solid wastes of normal refinery operation occur primarily as by-products of the adjuncts used in processing. The volatile character of these products and application of large heat quantities produce vapors, flue gases, and gaseous wastes. The release in excessive amounts of anything other than normal atmosphere constituents must be restricted. For example, the total combustion of pure hydrocarbons affords no pollution problems. It is the impurities in fuel and imperfect combustion that give difficulties. These appear as contaminants such as smoke, carbon monoxide, and sulfur dioxide.

Even the discharge of pure hydrocarbons from tank-venting systems, process equipment, trucks, and unnoticed



Flu gases, available at 15 psi from the catalytic cracker unit, are used to neutralize spent-caustic treating solutions to eliminate this serious problem

leaks, although apparently harmless, may be the medium whereby the odors of constituents in smaller concentrations are intensified to the point where they become a definite annoyance.

Adequate treatment and disposal of the refinery wastes necessitated many mechanical changes and additions to the refining equipment. As in most refineries today, a portion of the crude oil processed is high in sulfur content and contains relatively large amounts of hydrogen sulfide. Crude oil enters by pipe line and is discharged into the refinery crude fixed-roof tanks. Because these tanks are continuously filling or emptying, the changing volume of free vapor space in these tanks must be vented. If they were vented to the atmosphere, the gases from this source would cause appreciable pollution.

This condition is avoided by the use of a compressor, which continuously draws the vapors from the tanks, and discharges them to a furnace where they are burned.

Overhead gasoline from the crude units is condensed under moderate pressure, then charged immediately from the overhead receivers to a stabilizer. Here hydrogen sulfide is removed, by fractionation, prior to rundown storage without the use of caustic. Both the vented receiver gases and the stabilizer gases, which contain appreciable quantities of hydrogen sulfide, are burned as plant fuel.

In addition to crude and vacuum facilities, a catalytic cracking unit, viscosity-breaking unit, gas-concentration unit, polymerization plant, and a catalytic reformer are operated. With the exception of gas concentration and polymerization, these processes produce gases, which contain hydrogen sulfide and mercaptans. These gases are all handled under pressure and burned before discharge to the atmosphere. Some liquid streams are caustic-washed or treated with diethanolamine for hydrogen sulfide removal.

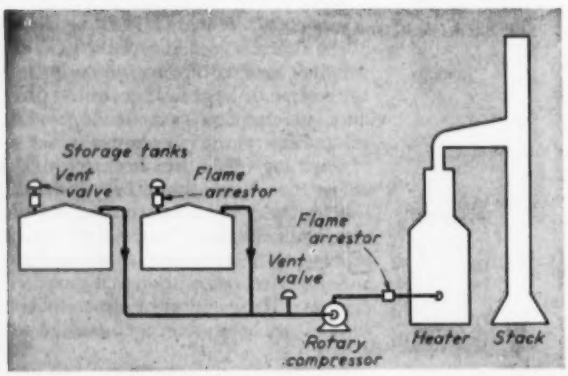
Vapors from the gasoline-blending tanks are recovered in a Hortondome system. These tanks, if vented to the atmosphere, would not release malodorous compounds, inasmuch as they are all doctor-sweet. However, a considerable amount of hydrocarbon vapors would be added to the air.

Each of the blending-tank vapor spaces is connected to the vapor space Hortondome. Here a flexible membrane provides a compensating volume to receive or discharge vapors displaced in blending operations. For safety, vent valves and flame arresters are provided in all cases. This system has reduced gasoline losses sufficiently to show a reasonably short pay-out, and it has appreciably mitigated the waste-disposal problem.

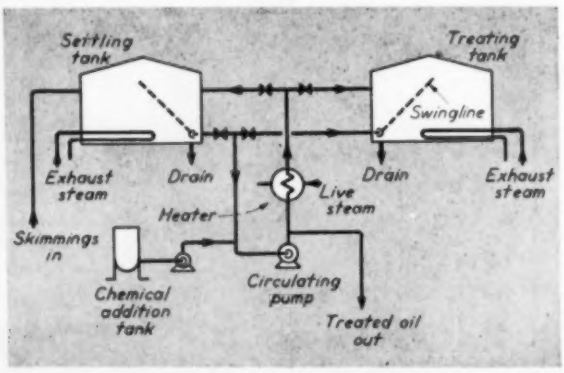
Large volumes of flue gas, readily available at a pressure of 15 psi from the catalytic cracking unit, are employed to neutralize spent-caustic treating solutions, thus disposing of what was once a serious problem. In this process a batch of spent caustic containing chiefly sodium sulfides, bisulfides, and organics is reacted with the carbon dioxide of the flue gas.

Chemical and physical stripping action of hot flue gases on the circulating liquid serves to react, volatilize, and remove the objectionable impurities. The disengaging drum, primarily an extension for the batch capacity of the system, serves also as a knockout pot for the exit gases. These gases subsequently are fed through a steam-aspirated burner to a heater before discharge to the atmosphere. The remaining solution of sodium carbonate is released to the city sewer.

Waste waters drained from refinery



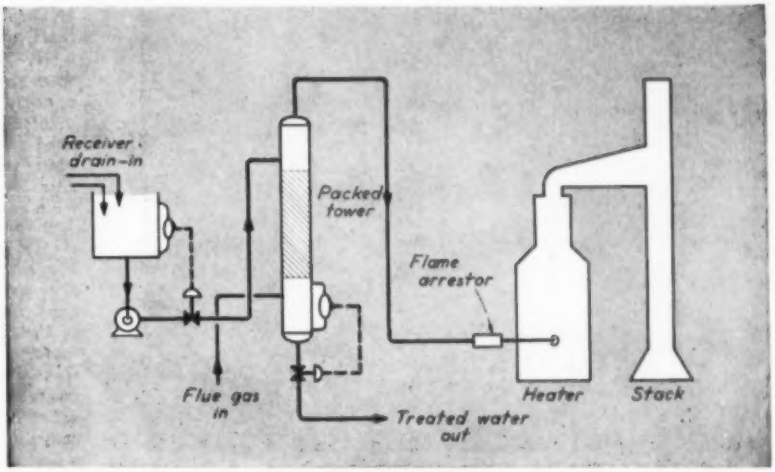
Gases from crude oil storage tanks are drawn off by means of a compressor and burned in a furnace before discharging



Oil suspended in water is removed in an API separator and an emulsion-breaking system before the water is discharged

receivers are treated in an analogous manner. Flue gases are passed through a plate absorption column, counter-current to the continuous flow of liquid cascading down the trays. Odorous compounds are stripped from the water, permitting safe discharge, and the effluent gases are burned in a furnace.

Oil suspended in water must be removed before discharge to the sewers. For this purpose an API separator and emulsion-breaking system are employed. Oil skimmings from the API separator are charged to the first tank of the treating system for further clarification, with the use of heat from low-pressure steam coils. Water is drained from this tank. For additional clarification the skimmings and unbroken emulsion are processed in the second tank by adding to them a sodium-carbonate solution and a patented chemical treating agent and then heating with live steam. After settling has taken place, the water is drained to the sewers, and the oil skimmings are combined and returned to crude-oil storage.



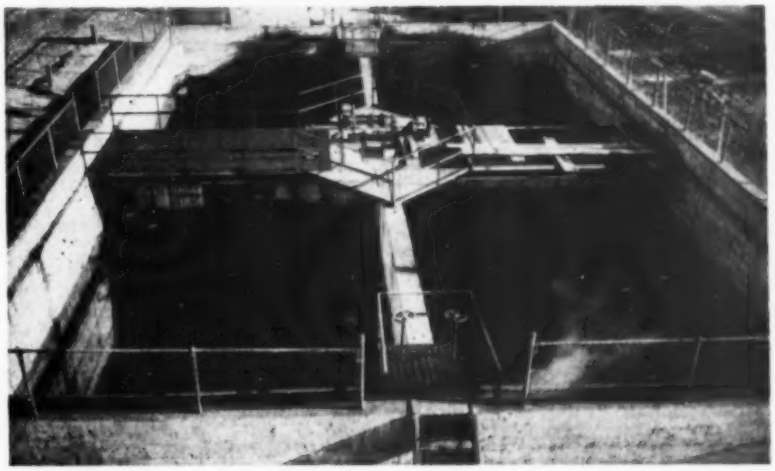
Waste water drained from refinery receivers is treated in a plate absorption column. Flue gases flow counterflow to the liquid cascading down over trays

Skimmers

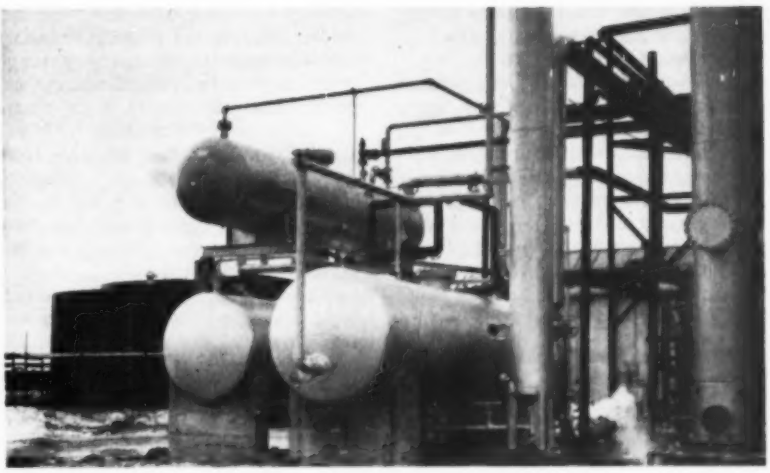
To avoid contamination of the crude oil with cracked products, a small trap is also operated ahead of the main separator, which separately skims cracking-plant drainage. The skimmings are then returned to the cracking-unit flash chamber. The use of the emulsion-breaking system in conjunction with the API separator avoids the accumulation and recirculation of emulsion, which would otherwise eventually overload the separator.

In general, smoke occurs when fuel is burned in amounts that vary too widely and erratically for adequate combustion. For example, process heaters, charged at essentially constant rates, might be expected to be relatively free of smoking difficulties. Boilers, which have firing rates depending on constantly fluctuating plant steam requirements, would not necessarily be smoke free. To meet the stringent requirements of municipal smoke regulation, smoke indicators were installed wherever such trouble was anticipated.

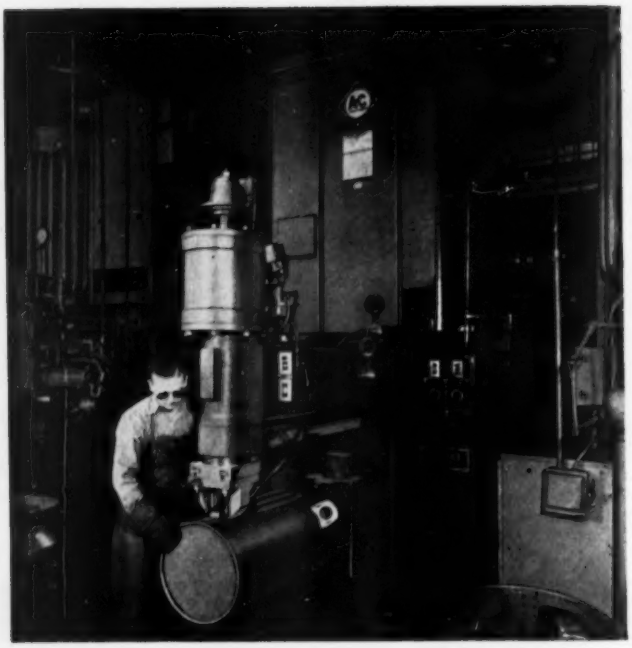
Probably the worst offender in this respect has been the emergency flare system, which was designed to relieve and accommodate relief gases from a multiple varying source. Such a system may be called upon to handle momentarily a thousandfold increase. The vapor-relief headers are all connected to a separator equipped with automatic level control and a pump whereby most of the entrained or condensed liquid may be recovered. Thus, liquid discharge to the flare is prevented, and appreciable amounts of liquid hydrocarbons are recovered.



An API separator skims oil from the top of the water and returns it to the clarifier. The water, free from crude, is then discharged to the main sewer



Disengaging drum, in foreground, serves as a knockout pot for the exit gases from the flue gas neutralization of the spent-caustic treatment solutions



Modern high voltage industrial distribution systems have done much to reduce difficulties formerly encountered when resistance welders were connected to low voltage, high impedance circuits. High voltage power is more readily available at the machine location, and larger sizes of welders may be treated as special purpose substations—each with its own supply transformer. Smaller voltage dips, isolation from other circuits, and better welds result

The simplicity of the basic resistance welding process and equipment is illustrated by the left hand sketch on the opposite page. The sketch to the right shows how high current, low power factor surges in the power demand can cause troublesome voltage drops in all of the circuits concerned. In addition to better power systems, other recent improvements include methods for reducing demand and transients, increasing power factor, and dividing load among phases

Power Supplies

Early in resistance welding development, the kva demand of machines was high and distribution systems were inadequate for them. This discussion analyses the original problems and shows how recent improvements are producing greater satisfaction for both distribution and welding engineers

A. B. WHITE, *Associate Editor*

TO understand how many difficulties with resistance welding supplies developed in the past and how the situation has improved, a quick review is helpful. The simple nature and perverse characteristics of the process and equipment and the type of power supplies formerly available were largely responsible for many unsatisfactory applications.

In its simplest form, the resistance welder is a transformer with a single turn secondary. Leads extend to the electrodes or tips between which parts to be welded are gripped. Line voltage applied to the primary causes a very high current to flow through the weld pieces, heating a small spot to the fusion temperature in spite of the low resistance. So much for the simplicity that helped make it popular.

Where Troubles Started

Assuming tip size, weld time, and weld current constant, resistance of weld pieces increases directly with thickness if current spread is neglected. Therefore, heat generated (I^2R) would increase in proportion. But other factors dictate that the weld diameter increase almost in proportion to thickness. To maintain intensity of heat input, current should increase directly as the thickness (with weld time constant).

The reactance of the loop formed by the upper and lower leads is usually several times transformer reactance (referred to the secondary circuit) and totals two or more times the entire secondary resistance. To double secondary (weld) current, secondary voltage would have to be doubled, making secondary kva proportional to the square of the current. This means reducing the transformer ratio by half, say from 100 to 1 down to 50 to 1. Thus by doubling the current and halving the ratio, primary current and kva have increased four times (primary and secondary kva are equal.)

Theoretically, then, with constant weld time, kva input to the welder will increase as the second power of thickness, or jump 4 times for each doubling of thickness. Fortunately, heat input also increases with weld time (heat is proportional to I^2Rt) and in most cases, time should increase with thickness, holding input down.

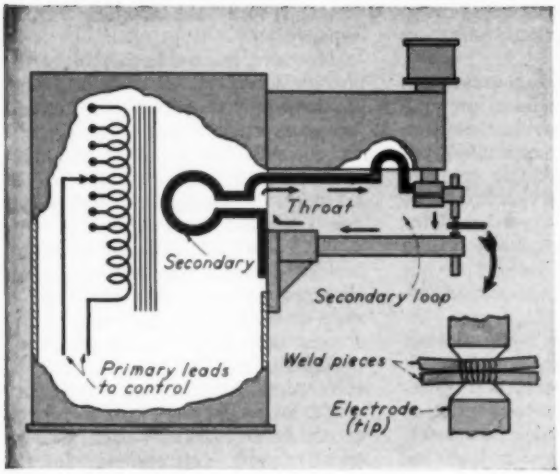
The above discussion does not consider the increased cooling effect and the comparatively larger size of electrodes on thin weld pieces which would make kva input relatively higher for low settings. However, the discussion may help explain why inadequate machines were specified or purchased if equipment size was compared to metal thickness. Or why it was felt that a machine or power supply that could handle one thickness easily, say on a low tap, could weld thicker material at the same speed. This happened often in the last war and the reconversion period.

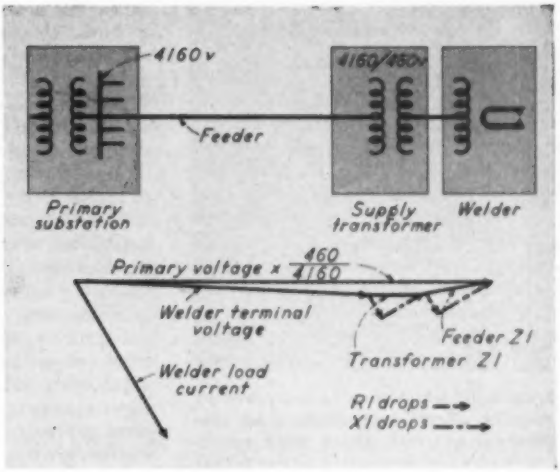
Inadequate Systems

To make matters worse, many companies had low voltage distribution systems loaded to capacity, and utilities were badly overloaded. Even though a machine setting high enough for satisfactory welds could be obtained, the surges often caused excessive voltage drop for other equipment and lighting. Thus because of inadequate equipment, power supply, and/or knowledge, many operators either tried to use too high a weld current, causing voltage dips, or alternatively, weld times so long that heat was conducted away from the weld area too fast to allow good fusion. Often, either result was enough to make management and design engineers avoid further use of resistance welding.

Confusion in Ratings

Confusion sometimes results from rating welders on an intermittent rather than a continuous basis. Thus, with the standard rating for a 50 per cent duty cycle, a 100 kva welder should be





and Resistance Welders

operated at only 70.7 kva with load current flowing continuously, since losses vary approximately as the square of the current. On the other hand, weld time is usually short compared to the time between welds and the machine may be designed for a maximum load of two or three times rated value, reducing recommended duty cycle to 12½ or 5½ per cent respectively.

Since the secondary loop is primarily reactance, power factor of the input of a single phase welder is very low. Thus a welder load may cause two or more times the voltage drop of a high power factor load of equal kva, or several times that of a load equal to *rated* welder kva.

Since weld time is very short, usually between 5 and 30 c, and frequently repeated, voltage variations caused by welders on other circuits, especially lighting supplies, are readily noticeable and irritating. The curve commonly quoted shows that sudden and recurring, but non-cyclic (less than one per second), variations of about 2 per cent in the lighting power supply become objectionable. Where variations become frequent and steady enough to become cyclic, the tolerable variation drops to about ½ per cent.

Last, but sometimes not least, many welder installations have started with the simplest equipment, which means a non-synchronous control for starting and breaking welding current. In the synchronous control, welding current is initiated at the normal or steady state zero point of the current wave (just ahead of the peak on the line voltage wave, except with phase shift, heat control circuits where initiation is delayed *each half cycle.)* Therefore no transients are involved.

With non-synchronous controls, however, welding current is initiated at random. Transients, corresponding to those accounted for by the 1.6 factor in calculating interrupting capacity of high voltage switchgear, occur. These random transients (which may be further increased by polarization in transformer cores) not only increase power supply surges but affect weld quality as well, especially for short weld times.

To these possibilities of unanticipated and excessive loads must be added the fact that most earlier types were single phase units which badly unbalance a three phase system. A single phase load will cause twice as much disturbance as the same load distributed on three phases.

Engineered Answers

In spite of the imposing list of drawbacks, an equally imposing list of advantages can be cited for resistance welders. Even single phase units have continued to be popular. With recent advances in welders, controls and power supplies, well engineered and completely satisfactory installations are becoming the rule rather than the exception.

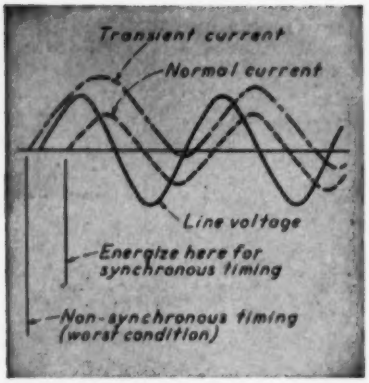
Obviously, reasonably close cooperation is necessary between the man responsible for specifying and/or operating the welder and the engineer responsible for the plant services since the power supply may drastically affect both weld quality and other equipment on the electrical system. Where the specifying engineer is experienced in resistance welding, little difficulty should be encountered for he will have become well aware of the problems. However, where one or two welders do not justify a specialist or where information is uncertain, the engineer designing the power supply may have to check for and obtain missing information. Manufacturers normally have all necessary design data available, including such items as feeder cable sizes. The larger welder sizes may actually become a special purpose substation and should be treated as such.

First step in assuring satisfaction is, of course, to specify a welder of adequate capacity for present or anticipated jobs. The power supply can then be designed for the maximum possible demand. It is undesirable to use anything less for it can be reasonably assumed that the machine will be operated under maximum conditions at some time.

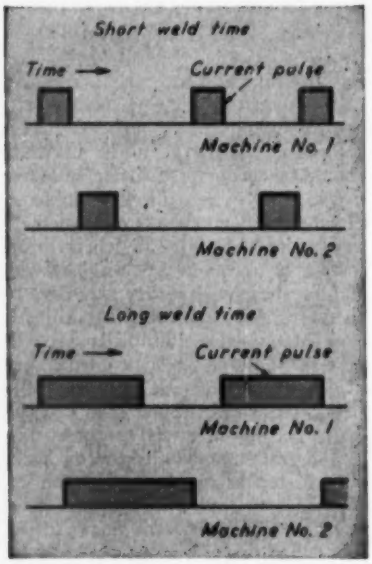
If the welder specified proves a burden on or exceeds the capacity of the power service available, it is quite probable that the equipment may be modified or supplemented, or alternates provided. Of course cost may increase because first proposals are often based on the simplest and cheapest equipment. In any case, the following discussion will indicate that the total cost of large installations should include necessary additions to the distribution and control system.

Modifying Weld Schedules

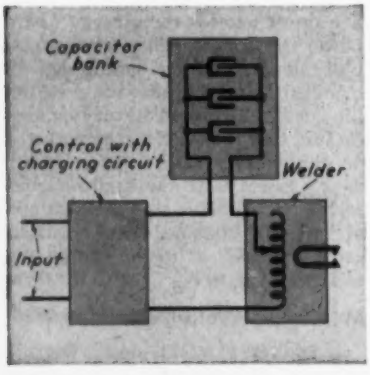
In addition to modifying kva demand by choice of equipment, it may sometimes also be reduced by deviating from recommended welding procedures as by using lower currents with longer weld



Transients, which may be increased by polarity effects, are avoided by synchronous controls, giving more consistent welds and decreasing power surges



Except with large numbers, value of dividing single phase welders among phases reduces when weld pulse becomes small part of operating cycle



Series capacitors can reduce the kva demand on single phase welders. They must be "tuned" with welder for each setting and kept charged between welds

times. Recommendations were set up to produce optimum results, which are not always required.

However, it is probable that although present product design allows low quality, future designs may be based on strengths listed for recommended conditions, forcing the welding engineer to return to the higher currents. Also, weld quality requires closer limits for hardenable steels, for alloys such as stainless steel (as where carbide precipitation is a factor) and for metals such as aluminum.

Capacities of utility systems have increased so that demand of individual medium and large welders is generally no longer an appreciable part of plant supply capacity. In those cases, voltage variations on utility lines are reduced to an unobjectionable value. However, it is wise to consult the utility before ordering a welder of appreciable size.

IMPROVED DISTRIBUTION

Possibly the most radical and valuable change has been development of distribution equipment which makes the load center distribution system practical and popular. This makes it easy and practical to isolate resistance welders of appreciable size from other loads, which is desirable because each has a detrimental effect on the other. The effect of welders on lighting has already been emphasized. But it should also be noticed that heat input to a weld varies as the square of the line voltage. Thus a 10 per cent change in voltage can cause approximately a 20 per cent change in weld heat, unless controls are compensated. Plus or minus 10 per cent voltage variation is considered the limit for ordinary welding, with much closer control required for critical material.

With high voltage power available for plant distribution, the simplest method may employ a separate step down transformer for each large welder or group of welders. The following discussion on factors involved in selecting the transformer will illustrate the desirability of isolation as well as the extent to which it may be necessary. The short cuts used in the example will be recognized as useful for illustration and estimation only and should be replaced by standard calculations where necessary.

Supply Equipment Capacity

For example, assume that a 100 kva resistance welder (either spot or seam) is to be installed and supplied from the high voltage system through a step down transformer. Because welder rating is based on a 50 per cent duty cycle, its continuous rating would be 70.7 kva and a 75 kva step down transformer should have adequate thermal capacity.

However, the welder is a highly inductive load, and the full load drop in the supply transformer in per cent is approximately equal to the per cent impedance. Thus, taking a round figure of 5 per cent for impedance (or reactance), the voltage drop would be 5 per cent when the welder is drawing only 75 kva. But since the maximum welder demand may easily be three times as great, the maximum voltage drop through the step down transformer alone may reach 15 per cent.

Furthermore, since the impedance of the feeders under normal design procedure may equal that of the transformer, the voltage drop in them must be added (along with the drop in the primary substation and supply if the welder size is an appreciable part of their capacity). Consequently, voltage drop at the welder terminals might readily exceed 30 per cent if selection is based on thermal capacity.

From the standpoint of supplying power to the weld, voltage drop at the machine terminals can be compensated (since it is caused by the welder itself) and would have no more effect on weld quality than an increase in welder throat depth; it would only limit the maximum current capacity. However, welder control power, particularly for electronic types, is normally taken from the main weld power source since both must agree in phase. High supply voltage variations therefore will cause malfunctioning and detrimental effects on the control.

Generally, then, the supply transformer and feeders should be sized for voltage drop rather than heat rise. If their capacity is doubled, voltage drop is halved, and so on. And if their capacity is made equal to maximum welder demand, voltage drop becomes approximately equal to per cent impedance. Variations should be kept low as possible, but each installation must be considered individually.

With extra capacity in supply feeders and step down transformers, thermal considerations would allow extra welders on the secondary side. For example, assume a 150 kva supply transformer and correspondingly large feeders were selected. Two 100 kva welders might be used and the voltage drop for each would be reduced to 7½ to 15 per cent, depending on feeder impedance. This much reduction in welder output might be tolerated and control voltage variations might be handled by voltage regulators.

However, unless the welders were interlocked to prevent firing at the same time, each would cause a 7½ to 15 per cent variation in the weld current of the other. Since this variation cannot

be anticipated, compensation is impossible and weld quality would suffer. Interlocking is sometimes practical for a small number of welders, but it is bound to cause confusion and delayed production for more than two or three.

As the number of welders on one supply transformer increases, conditions may improve. For example, a 500 kva transformer would have thermal capacity for seven 100 kva welders. At a near maximum demand of 200 kva, each welder would cause a voltage drop of 200/500 times 5 per cent or 2 per cent, plus the corresponding drop in the feeder and the rest of the system. It is very unlikely that all welders or even the majority will be energized at one time (especially with short or varying weld times). The method's value may depend on weld quality required, welding times (on and off), and the number of welders. Welders should be grouped to avoid long secondary runs.

Load on Substations

To extend the preceding reasoning, a 100 kva welder connected to a 500 kva load center substation (single phase) would cause a 2 per cent variation at the substation alone, plus the drop in the primary distribution circuits. If the substation also supplies power for lighting or other critical loads, the variation would not be excessive providing primary circuit impedance is very low and providing weld intervals are infrequent and non-cyclic. If primary impedance is normal or if the welder is of the seam or pulsation types, the variations would definitely be excessive for lighting circuits. They might also cause disturbances in some types of regulated circuits.

On the other hand, voltage variations due to other loads on the substation may be detrimental to weld quality, even though relatively slow or infrequent. Changes in load at the beginning, during and at the end of the work period, starting of or intermittent loading on heavy motors, and the like can easily cause variations resulting in spitting or burning at the weld for high voltage, and lack of fusion for the lower values. Thus, isolation of power supplies to reduce variations common to both is desirable to the greatest extent economically feasible.

Normally the primary substation of the plant will be common to all supplies and the same method of estimating voltage drops may be used. Therefore, a 100 kva welder with a 200 kva maximum demand would be expected to cause a 1 per cent voltage variation in a 1000 kva, 5 per cent impedance primary substation transformer (single phase).

Since the utility supply impedance should be much lower than that of the transformer, the variations caused in the rest of the plant should not be objectionable if weld current pulsations do not exceed two or three per second. Variations in the utility lines would be negligible.

DEVELOPMENTS IN WELDERS

One of the earliest practical developments was the synchronous weld timer (contactor) which avoids the transients in the weld power, reducing spitting and burning at the electrodes as well as peak surges in the supply system. Cost is greater, but synchronous contactors should be definitely considered for at least the larger single phase machines. On many applications, they are necessary for weld quality.

Another recent advancement in single phase controls is slope control which, over a period of several cycles, gradually increases weld current to its maximum value. Similar circuits reduce current at the end of the weld period at predetermined rates. While not of wide importance, this type of control may avoid the instantaneous changes upsetting to some regulated circuits.

Capacitors for Power Factor

Use of shunt capacitors to correct power factor of resistance welders is impractical in most cases because of the intermittent current flow. However, series capacitors have often proved valuable and have reduced kva demand to an extent that allowed otherwise impossible installations at a reasonable cost. The capacitors can correct power factor to unity but must be "tuned" with the welder for each appreciable change in current setting. A special control keeps the capacitors charged to the voltage existing under steady state conditions at the instant current is initiated.

So far, the welders have been considered as single phase loads, but possibility of distributing a number of welders on various phases has not been mentioned. There is possible value in dividing the thermal load. But while it is true that if welders were on different phases when energized simultaneously, the *total* percentage voltage drop would be lower, it is also true that the transformer (or windings) supplying each phase would normally be smaller, resulting in higher drop to begin with.

Multi-Transformer Units

One recent development in single phase units, however, may often be valuable in balancing the load on three phase systems for high production items. This is the multiple-transformer type of multiple-point spot welder. The transformer used has short secondary leads close together and connected to electrodes for either single spot or two closely spaced welds in series.

A number of transformers and electrode systems are mounted in a platen type press so that many spots may be made with only one loading operation. Transformers may be distributed on various phases and groups may be energized in sequence. But note that, because of the secondary loop can be so small, both kva size of transformer and kva line demand are minimized.

The stored energy types of welder which became popular during the last war allowed energy to be stored in capacitors, inductance, storage batteries

(Continued on page 100)

Three phase welders appear to offer one of the best compromises for lowest kva demand and best weld quality for most materials, but particularly for hard to weld types that tax even the best power systems. Power demand is not only reduced but divided among phases. The single phase, 120 c power pulsations which sometimes affect weld quality are avoided. A number of low frequency or rectifier welder types are now manufactured

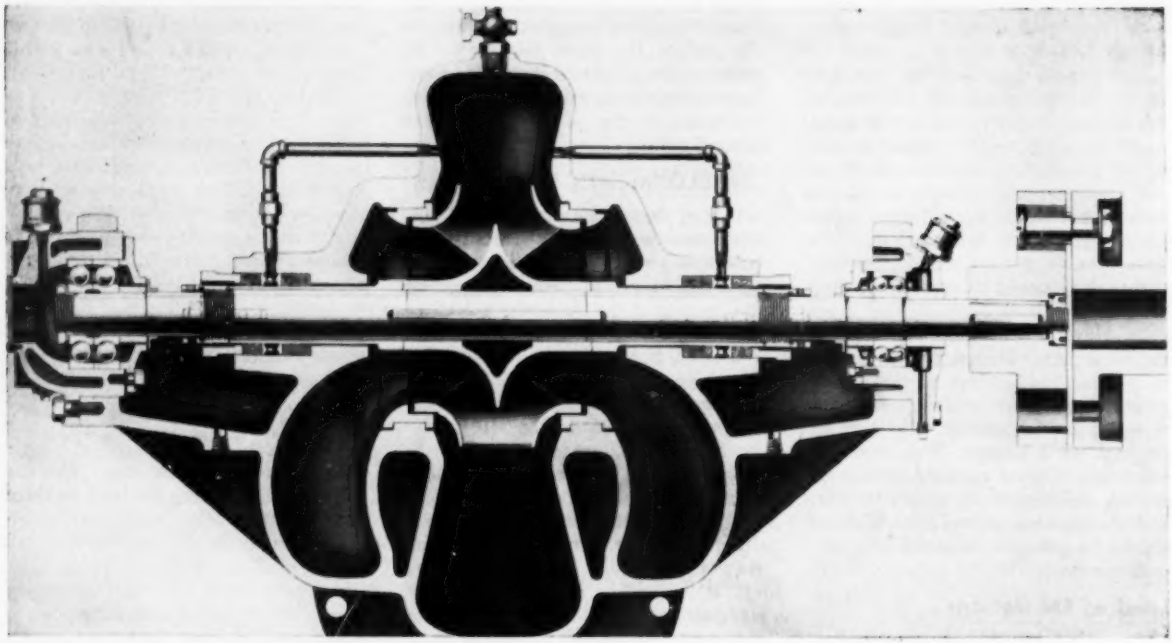


Fig. 1—This typical shaft assembly for a single stage pump has a step-down shaft for bearings, sleeve, and lock nuts

Centrifugal Pumps . . .

Here are the particulars concerning structural details of shafts and shaft sleeves. The authors, in a step by step procedure, discuss critical speed, shaft deflection, and shaft and sleeve design. They also explain the applications to which both can be adapted

IGOR J. KARASSIK & ROY CARTER
Worthington Corporation

BECAUSE vibration of the rotating element must be avoided, the proper design of the pump shaft is an extremely important factor in the ultimate successful operation of the pump.

Actually, the shaft of a centrifugal pump is the center of the rotating element, and it is designed to give a certain maximum deflection. This generally results in shaft diameters in excess of safe needs of actual strength for torque transmission. Transverse loading, its distribution, the shaft span, and shaft diameter determine the minimum deflection for the static conditions, that is, when the pump is not rotating. When the shaft rotates, there are naturally reversals in stress that affect the life of the shaft.

In general, the shaft is proportioned so that it can successfully withstand stresses set up when the pump is started up quickly as for instance, when the

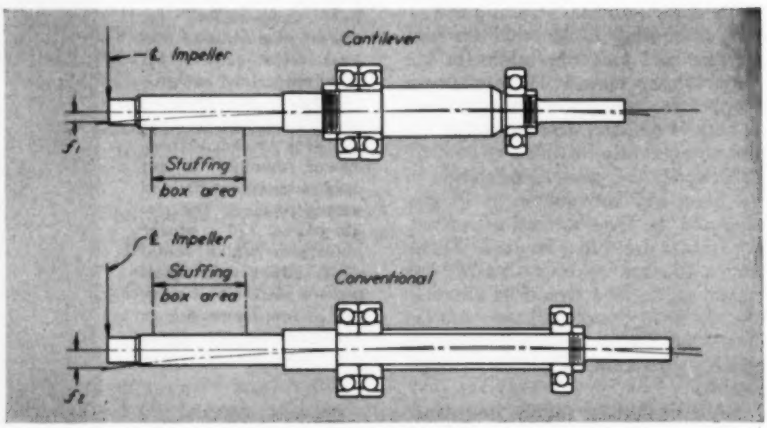


Fig. 2—Here is comparison between a cantilever and conventional shaft designed for an end suction overhung impeller pump. To reduce the shaft deflection at the impeller and stuffing box, the shaft diameter is increased appreciably between the two bearings

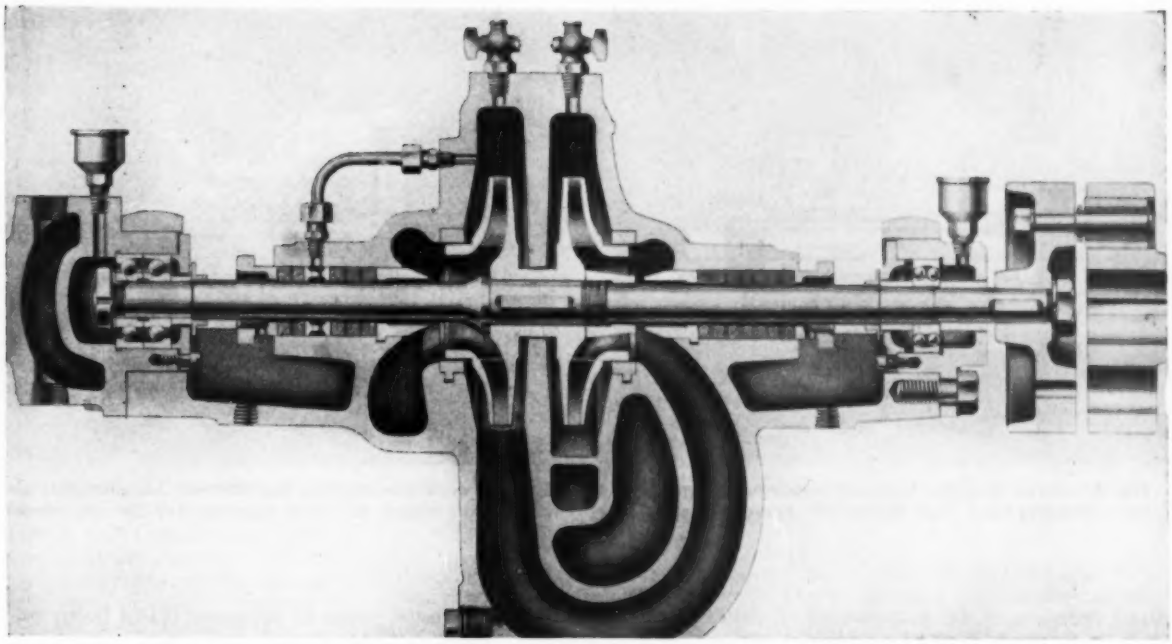


Fig. 3—This medium two stage pump has a stainless steel shaft and no sleeve. Application is ideal for small pumps

Structural Details ... Shafts and Shaft Sleeves

driving motor is thrown directly across the line. Again if the pump is handling hot liquids, the shaft is designed to withstand the stresses set up when the pump is started from a cold condition without a preliminary warming-up.

Critical Speeds

Since the shaft diameter is intimately connected with critical speed, a few facts of a general nature on the subject of the critical speed must be presented.

Any item made of an elastic material has a natural period of vibration. When a pump rotor turns at any speed that corresponds to its natural frequency, any minor unbalance will be magnified. These are the critical speeds. Due to variations in the density of metal and minor irregularities, having the center of mass exactly on the axis of rotation is impossible. Thus, even in vertical shafting where there is no deflection due to the weight of the parts, this eccentricity of the center of mass causes a centrifugal force and, therefore, a deflection and vibration.

Lowest critical speed is called the first critical speed, the next higher is called the second, and so on. Obviously, the maximum vibration of the revolving shaft and the parts attached thereto will occur at the critical speed. However, any deviation from the exact value of the critical speed restores to the shaft its elastic resistance.

In centrifugal pump nomenclature, a rigid shaft means one whose first critical speed is higher than the operating speed, while a flexible shaft is such that the operating speed is higher than its first critical.

Once the operating speed has been selected, the designer still has to determine the relative shaft dimensions, in other words to decide whether the pump will operate above or below the first critical speed. Generally speaking, the shaft dimensions of single stage centrifugal pumps are such that the operating speed is considerably lower than the first critical. However, the designer has to face this problem when it comes to laying out a multi-stage pump.

Deflection

In order to understand the effect of critical speed selection upon the shaft size, it is necessary to consider that the first critical speed of a shaft is linked to the static deflection of this shaft by a fixed mathematical relation. The shaft deflection depends upon the weight of the rotating element, the shaft span, and the shaft diameter. The basic formula is as follows:

$$f = \frac{WL^3}{mEI}$$

Where:

- f, deflection in in.
- W, weight of the rotating element
- L, shaft span in in.
- m, coefficient depending on method of shaft support and distribution of load
- E, modulus of elasticity of the shaft material
- I, moment of inertia, $d^4/64$

This formula is now in its most simplified form, that is for a shaft of constant diameter. If, as is usually the case, the shaft is of varying diameters, the calculations for shaft deflection are more complex, and generally it becomes more practical to solve for the deflection graphically.

Actually, this formula solves for the static deflection, which alone enters into the computation of the critical speed.

This article will be included in a book on centrifugal pumps now being prepared by the authors; hence, all rights to republications are reserved by them.

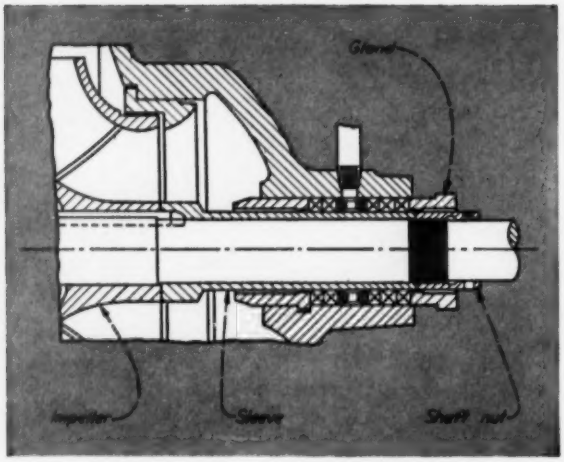


Fig. 4—Sleeve with the external locknut and impeller key extending into the sleeve to prevent slippage

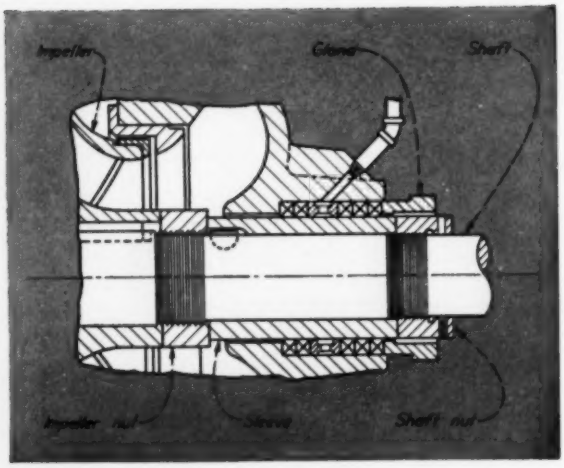


Fig. 5—Sleeve construction has internal impeller nut, external shaft sleeve nut, and separate key for the sleeve

Actual deflection of the shaft—which needs to be determined to establish the minimum permissible internal clearances—must take into account all the transverse hydraulic reactions on the rotor and other external loads, such as belt pull and weights of the rotating element.

For practical purposes, the first critical speed in rpm can be calculated as:

$$N_c = \frac{187.7}{\rho \cdot \delta}$$

A pump operating at 1750 rpm will generally have a shaft with a critical speed above the operating speed, such that the calculated deflection is about 0.005 to 0.006 in. in order that contact of the rotor with the stationary wearing rings is avoided. On 3600 rpm multi-stage pumps, shafts of equal stiffness are used, again to avoid contact at the wearing rings. However, the corresponding critical speed in this case is below the operating speed, somewhere between 60 and 75 per cent of the latter. This is sufficient margin to avoid potential danger of operation in the close vicinity of the critical.

Shaft Design Details

As long as the operating speed is sufficiently removed from the critical speed, and as long as the shaft deflection is properly taken in consideration in setting the running clearances, it matters very little whether the first critical speed is above or below the operating speed. A well balanced pump with a flexible shaft is a safer piece of equipment than a poorly balanced rigid shaft pump.

Shaft diameters are generally in excess of the dimensions actually needed to transmit the torque. This, incidentally, should be, for ease of assembly demands that the shaft diameter be stepped up several times from the coupling end to its center where the impellers are to be mounted. Fig. 1, which shows a typical shaft assembly for a single stage pump, illustrates this excellently. Starting with the maximum diameter at the impeller mounting, there is a step-down for the internal nuts holding the impeller, a second step-down for the shaft sleeve, a third for the external or sleeve shaft nut, followed by several more steps for the bearings and the coupling. The shaft

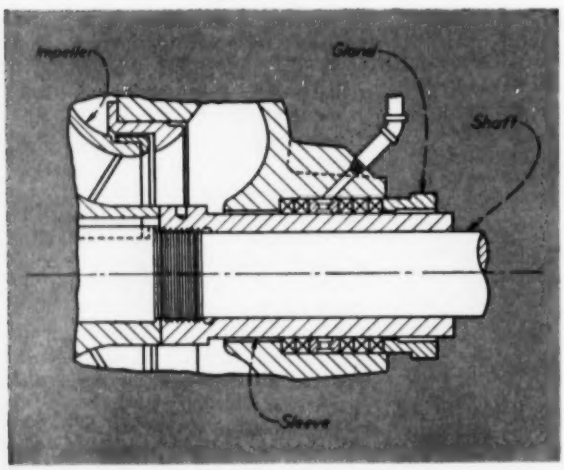


Fig. 6—Impeller end of this sleeve is threaded and screwed onto the matching thread of the shaft to insure safety

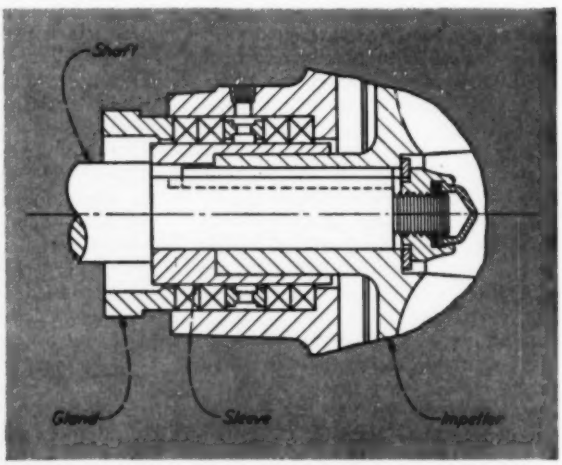


Fig. 7—Pumps with overhung impellers have sleeves with hubs extending into the stuffing box to protect the hub

diameter at the impellers not only exceeds that required at the coupling for torsional strength, but care must also be taken in the design to provide sufficient diameter difference for the necessary steps.

One frequent exception to the oversizing of the shaft at the impeller mounting is the case of units made up of two double-suction, single-stage pumps operating in series when one of the pumps has a double extended shaft. Since this pump has to transmit the total horsepower for the entire series unit, the shaft diameter at its inboard bearing may have to be increased in excess of the normal diameter.

Shaft design of end-suction, overhung-impeller type pumps presents a somewhat different problem. One of the solutions used to reduce the shaft deflection at the impeller and at the stuffing box (where concentricity of running fits is extremely important) consists of increasing the shaft diameter very appreciably between the bearings, as illustrated in Fig. 2. Another solution is to shorten the shaft span between the bearings. This, incidentally, results in a much more compact unit.

Shaft Sleeves

Function of a shaft sleeve is to protect the shaft from corrosion, errosion, and wear. By the use of shaft sleeves, wear, errosion, and corrosion do not affect the shaft strength, and maintenance cost is reduced. There are many forms of shaft sleeves used in centrifugal pumps, the most common being those to protect the shaft where it extends through a stuffing box. Generally sleeves serving other functions are given specific names to designate their purpose.

In extremely small size pumps, the use of shaft sleeves presents certain disadvantages. Since the shaft sleeves cannot contribute to the strength of the shaft to any appreciable degree, the shaft itself must be designed for the full maximum stress. The shaft diameter is then increased very materially through the addition of the shaft sleeve since the thickness of the latter cannot be decreased beyond a certain safe minimum. As a result, the impeller suction area may become dangerously reduced, unless the eye diameter is increased to maintain a constant eye area, which in turn increases the pick-up speed unfavorably. Further disadvantages result from increased hydraulic and stuffing box losses resulting from an increase in the effective shaft diameter out of proportion to the small size of the pump.

In order to eliminate such shortcomings, very small pumps are frequently furnished with shafts, which have metallurgical properties of corrosion and wear resistance sufficient to permit satisfactory operation without shaft sleeves. Such a pump is illustrated on Fig. 3. This obviously leads to a less expensive construction, and that the cost of replacing a shaft when it is sufficiently worn is of the same order of magnitude as the cost of new sleeves plus the cost of their installation.

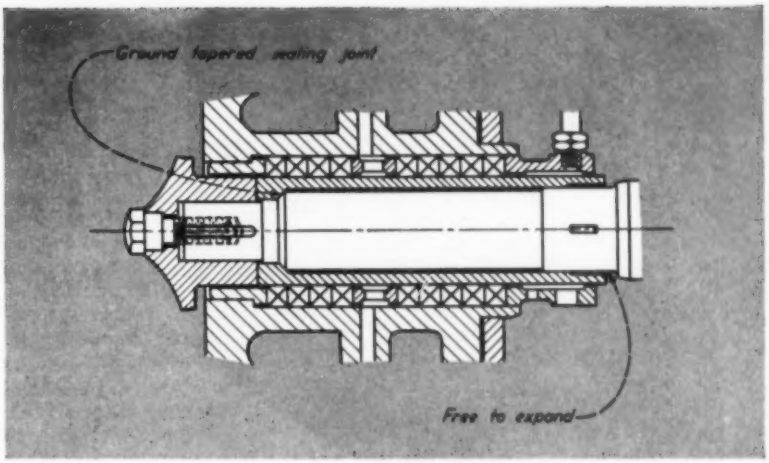


Fig. 8—Designs specifically for high temperature and pressure require refinements in construction, such as packing between shaft sleeve and impeller

An interstage or distance sleeve is employed to protect the shaft between the impellers of a multi-stage pump. In some cases, these impellers are cast with long hubs, so that they perform the same duty, eliminating the necessity for the sleeve.

In medium size centrifugal pumps with two external bearings on opposite sides of the casing—the common double-suction and multi-stage varieties—the favored shaft sleeve construction at the stuffing boxes is one in which the sleeve is held in axial position against the impeller hub by an external shaft nut. The shaft sleeve is prevented from rotating by a key, usually an extension of the impeller key, as illustrated in Fig. 4. When the pump has considerable axial thrust for some reason so the frictional grip of the impeller on the shaft is exceeded, this axial thrust is transmitted through the sleeve to the external shaft nut. In larger, high head pumps, the possible axial load on the sleeve may be high, favoring a design as shown in Fig. 5. This has the added commercial advantage of a simple, less expensive, sleeve to be replaced when worn.

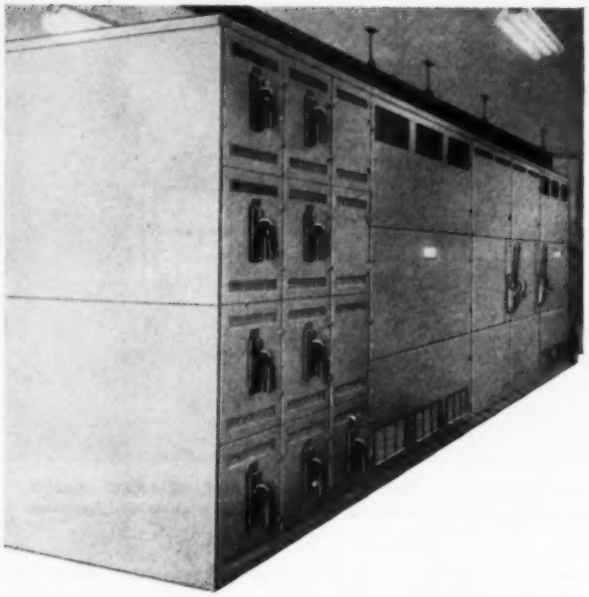
A few manufacturers have favored a sleeve design as shown in Fig. 6. Here the impeller end of the sleeve is threaded and screwed on a matching thread on the shaft. With this type of sleeve a key cannot be used, and right and left hand threads are used so the frictional grip of the packing on the sleeve will tighten it against the impeller hub. With sleeve designs as in Fig. 4 and 5, right hand threads are usually employed for all the shaft nuts, as the sleeve is prevented from rotating in the shaft by keys. As a safety precaution the external shaft nuts, as in Fig. 4 and 5, and the sleeve, as in Fig. 6, have set screws as a locking device.

In pumps with overhung impellers sleeves take various forms. Often the stuffing boxes are close to the impeller, and the sleeve actually protects the impeller hub from wear as in Fig. 7. Having a portion of the sleeve fitting on the shaft allows holding it from rotating by the impeller key, while it is held in an axial position because a portion of the sleeve is clamped between the impeller and a shoulder in the shaft.

When pumps are specifically designed for high temperature or high pressure service, a refinement of construction may be introduced. This consists of packing between the shaft sleeve and the adjoining impeller hub that prevents all possibility of leakage between the sleeve and the shaft. Another design intended to accomplish the same results is illustrated in Fig. 8. The contact surface of the sleeve is machined with a 45 deg bevel, and while one end of the sleeve is locked, the other end is free so that it may expand without constriction under the effect of temperature.

ERRATA

Acknowledgement is made of an error in Fig. 6 of "Structural Details and Axial Thrust of Centrifugal Pumps" appearing in the January 1953 issue of I&P. The value 120 psi should be 1200 psi, as given in the text.



Selecting Taps On Power Transformers

FRANK E. REEVES, *Electrical Engineer*

THE GRAPHICAL METHOD of showing relation between source voltage, impedance and line drops and resulting load voltage extremes is illustrated by the diagrams below and will be found useful to determine:

1. Rated voltages of generators, transformers, and other equipment, before purchase.
2. If standard transformers may be used for a particular application.
3. How the taps should be specified for optimum operating conditions.
4. Best tap settings on installed power transformers

Use this graphical method to help visualize voltage drops in the electrical system and predict the optimum transformer tap settings

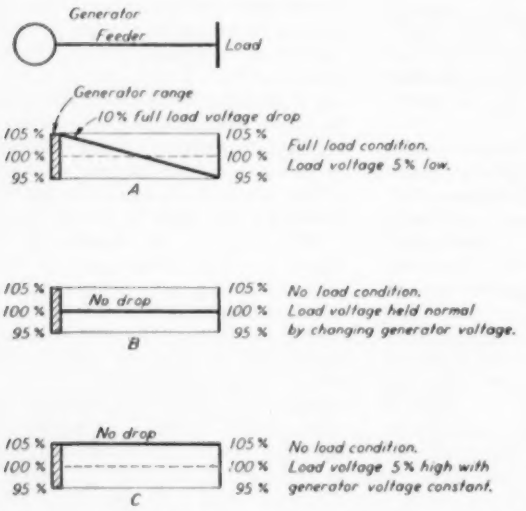


Fig. 1—A simple case, with no transformation between source (generator or regulator) is used here to illustrate graphic method of representing system voltages. Standard voltage range for generator is 10%. Full load voltage drop on feeder is assumed to be 10%. This simple example is used only to introduce method.

A—To prevent greater than 5% drop in load voltage, generator is run at "full raise" under full load conditions. The 5% drop at load cannot be avoided without a voltage regulator or higher nominal generator voltage.

B—No load conditions are shown, with no drop in the feeder. Load voltage may be held at its nominal value by lowering generator voltage 5% to rated value.

C—No load condition when generator voltage is unchanged from the full load value is shown. Load voltage rises to 105% which is permissible in this example and in most installations.

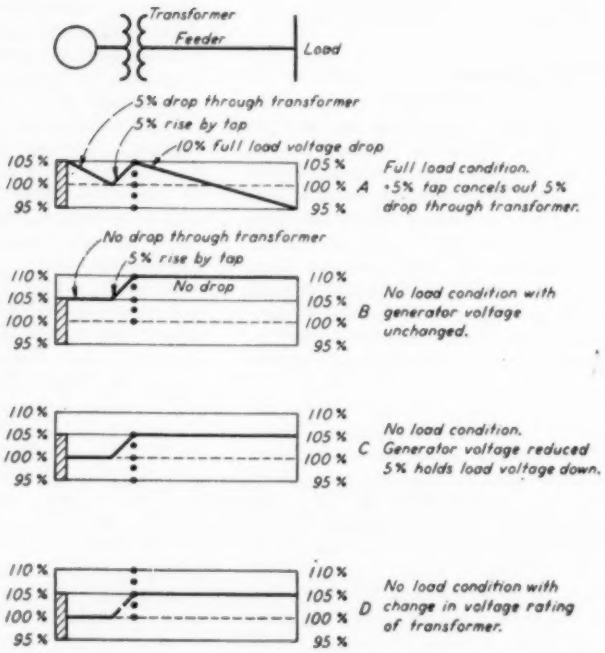


Fig. 2—This is a graphical example with one transformer bank between generator and load. Series of 5 vertical dots indicates tap range. Short horizontal line through dot indicates tap at rated voltage of transformer.

A—Under full load condition, 5% tap offsets 5% assumed drop through transformer and load voltage is 5% low.

B—Under no load, high tap boosts voltage 5% and load voltage is 10% high without automatic regulation.

C—Generator voltage is reduced 5%, and load voltage is only 5% high. Generator could be operated at full buck and load voltage would be nominal value.

D—In A, B, and C, transformer is on its maximum voltage tap. Possibility of changing the transformer voltage rating should be explored to determine if the middle tap could be used for normal operation, with possibility of future change.

(assuming manual tap changers) to avoid frequent changes.

5. Whether automatic voltage regulation is necessary and where it could be applied most economically.

A considerable saving can be realized in both first cost and maintenance if manual rather than automatic tap changers can be specified for new transformers. Also, need for automatic regulators may be eliminated by studying voltage under all loading conditions. The study may be made graphically after feeder voltage drops, regulation of transformers and other factors have been determined.

A further saving may be possible if transformers conforming with standardized design or "repetitive manufacture" types are used. If special designs are required, more engineering work would be necessary, with the units made from special drawings. In such cases, prices may be considerably above those for quite similar standard units. A thorough study of voltage conditions may reveal that taps provided on standard designs may be used.

Although standard voltage taps vary somewhat in different types and sizes, the most common power transformers have five high voltage connections. These are in 2½ per cent steps, based on nominal high voltage rating. Actual ratios obtainable with the five taps are usually at the discretion of the purchaser. For example, the buyer may specify two taps above and two below nominal voltage. Or he may specify three above and one below (three up and one down); or one above and three below (one up and three down). For any of these arrangements there would probably be no increase in cost, provided the nominal voltage rating is standard.

In the voltage diagrams shown, the following assumptions have been made:

1. A full load voltage drop of 5 per cent through each transformer.

2. Load voltage permitted to vary from minus 5 per cent maximum under full load conditions to plus 5 per cent (or plus 10 per cent in one case) under light load conditions.

3. No line or transformer voltage drops under light load conditions. (This is an extreme condition seldom found in actual practice, but is on the "safe" side.) Line voltage drops under full load are indicated on the diagrams.

4. Generator voltage may be varied through its entire 10 per cent range, to maintain best possible load voltages.

The diagrams in Fig. 1 are given to show the method of graphical presentation of voltage variations, without transformers. In such a simple application, a graphical study would be unnecessary. The line impedance drops used in the examples may not be representative in many cases but are so chosen to best illustrate the basic principles involved.

It is interesting to note that in Fig. 2, diagram *B*, 110 per cent voltage is impressed on the 105 per cent transformer tap. This condition will be found in other diagrams, and happens more often than not in actual practice. For example, a transformer having a tap rated at 13,200 v may actually operate at potentials to 14,400 v or even higher. Transformer taps are rated in voltage in order that ratios may be in more usable form than if expressed in decimals. Tap ratings in no way limit voltage which may be applied to the taps, within reasonable limits.

Another important factor is that transformer taps and ratios are based almost invariably on *no-load values*, or are very close to turn ratios. This fact is sometimes overlooked.

Taps are seldom on the end turns of a winding. The winding is opened at some convenient point, preferably where the potential to ground is low, and adjacent parts equipped with taps. These taps are brought to pairs of terminals, each pair corresponding with a particular tap or ratio. Only one pair is connected at a time, usually by a heavy duty selector switch, remotely operated through insulating rods and linkages. Taps may be changed without disturbing the permanent phase connections.

In modern transformers, the operating handles of tap changers, together with the dials which indicate the particular tap connection, are on the sides of the tanks, at approximately eye level.

Voltage taps are usually on the high voltage windings so that they may be designed for the lower current.

The following may be helpful in avoiding confusion in tap changes:

1. At the generator or sending end where nominal input potential is to be held constant on a transformer used to step up voltage, raising a tap on the high voltage side will increase potential on that side.

2. At the receiving end (or at the load) with nominal input potential held constant on a transformer used to step voltage down, raising a tap on the high voltage input side will lower potential on the load side.

The above rules will suffice in most cases, but the following statement will apply in all cases: With voltage held constant on the input side of any transformer, raising a tap on the output side will raise voltage on that side; raising a tap on the input lowers output voltage.

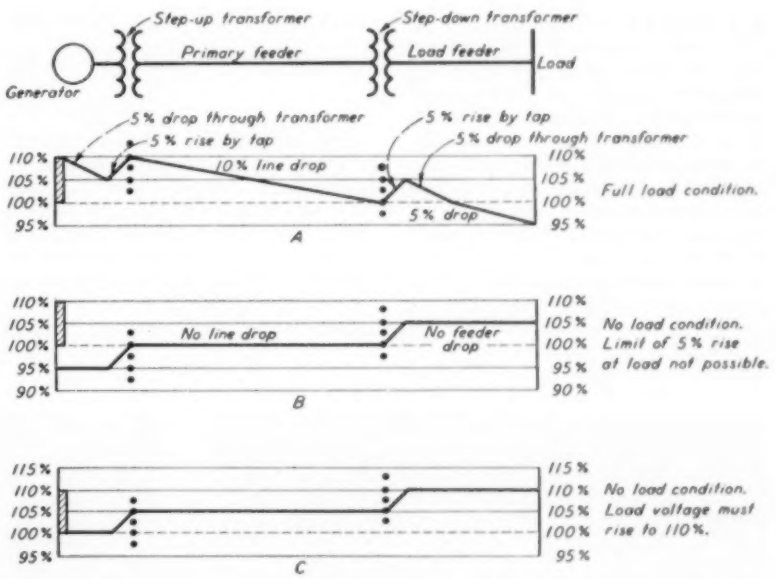


Fig. 3—Case with two transformers between generator and load is shown above. Note that generator nominal voltage is 105%, rather than 100%; also that an extra tap is available on both step-up and step-down transformers. These conditions are frequently possible without deviating from standard generator and transformer designs. The possibility of at least one extra tap change is desirable to provide for unforseen circumstances. Taps on step-up transformer are "three up and one down"; and on step-down tansformer, "three down and one up" (above and below nominal voltage) in the diagrams above.
A—The generator must be run at full boost to limit load voltage drop to 5%.
B—A limit of 5% rise under no load conditions is shown to be impracticable.
C—With generator at full buck, load voltage rise at no load is 10%.

power transmission

selection • application • operation

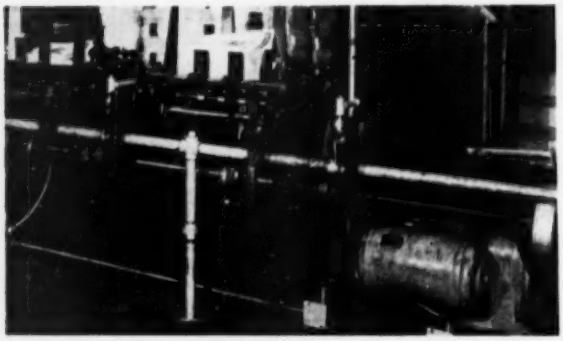


Fig. 1—Packaged variable speed motorized drive, rated 3 hp, is utilized for inching service on newspaper press

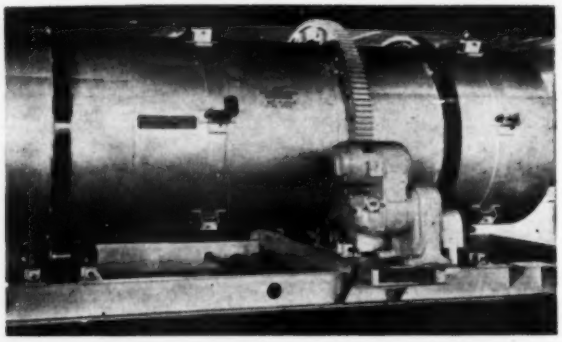


Fig. 2—Compact motor and gear unit provides the slow rotating speed of 78 to 26 rpm to mill without slippage

Drives to Fit Any Application

FRANCIS A. WESTBROOK

Many different types of drives are available to industry for a variety of conditions. Here are fifteen case histories that cover several V-belt, flat belt, fluid and motorized drive applications

VARIETY AND EXTENT of drives available to meet almost every conceivable set of operating conditions are probably not fully realized, and in order to give at least a glimpse of the many methods of industrial power transmission a few examples have been selected more or less at random. All are modern drives, and all are giving satisfactory service. Most of them, if not all, are susceptible to modifications and combinations to meet specific conditions.

Fig. 1 shows a packaged variable speed motorized drive with a 3 hp motor used for inching service on a newspaper press. Fig. 2 illustrates a mill with a 15 hp motor delivering 78-26 rpm. The latter embodies a gear and pinion and permits slow rotation of the mill without slip. Both drives are very compact, taking up a minimum of space and are easy to install. Furthermore, speed control is readily adjusted to any desired rpm. This type of packaged drive represents a definite modern trend.

Fig. 3 shows a variable speed drive with chain and sprocket transmission that regulates the speed of two reciprocating plate feeders delivering ore from storage to roasting ovens. The constant

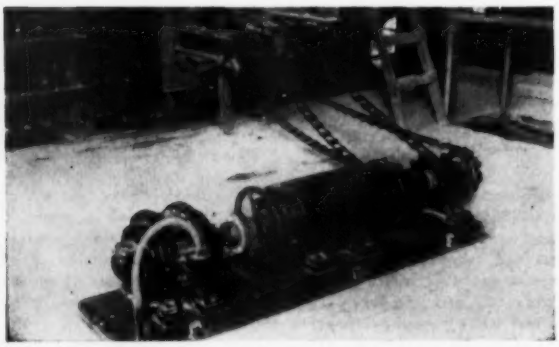


Fig. 3—Variable speed drive, with chain and sprocket, regulates the speed of two reciprocating plate feeders

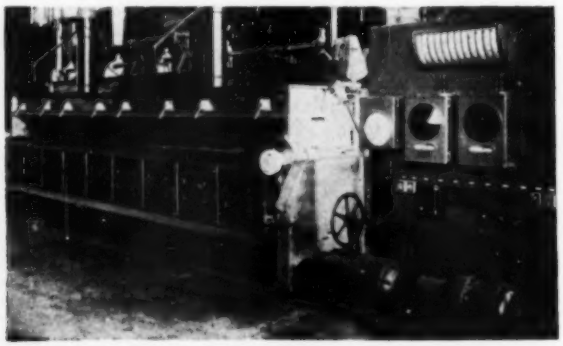


Fig. 4—Chain grate stoker speed is varied by handwheel adjustment located conveniently in front of panel board

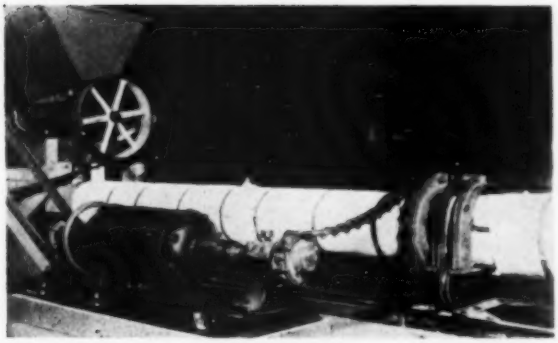


Fig. 5—Slate roofing granules are being handled for a rotary painting and drying conveyer at very slow speed

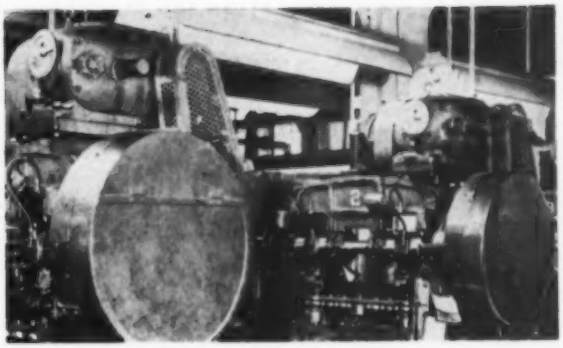


Fig. 6—This compact variable speed reducer, located on top of press, can be controlled readily by the operator

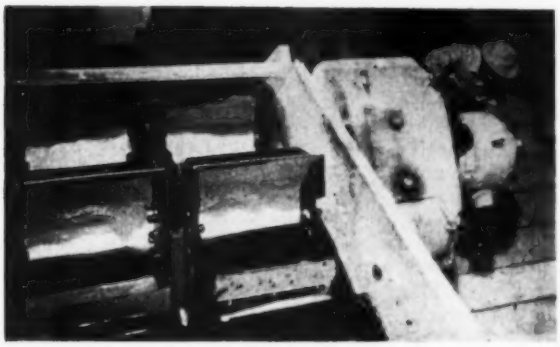


Fig. 7—Gear motor maintains a constant speed on this heavy conveying equipment. Unit is conveniently located

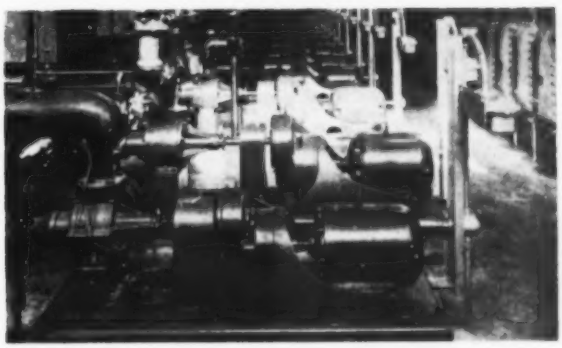


Fig. 8—All of these 17 oil pumps are driven with individual gear reduction units powered with 7½ hp motors

speed motor with the speed changer can be seen at the left. Handwheel for adjusting the speed is between the motor and changer. Adjustments may, under certain circumstances, be more conveniently made by a handwheel located as seen in Fig. 4. This unit drives a chain grate stoker in an industrial power plant. Fig. 5 shows another application of this type of drive with a large speed reduction employing a chain and sprocket for a rotary painting and drying conveyer handling slate roofing granules.

In many instances the wheel for adjusting the speed is controlled from the floor above or below, or from some other convenient location. In this case a chain with a sprocket is installed in place of the wheel and another sprocket with a crank at the control point. Such arrangements are, of course, used with other makes of variable speed units. Another compact variable speed drive for a press is seen in Fig. 6, with the speed setting dial plainly visible and the whole unit mounted on top of the machine.

The drive for heavy conveying equipment in Fig. 7 has a constant conveyer speed, while the motor speed varies. Consequently a compact gearmotor type of drive is employed that is totally enclosed, making it safe and easy to maintain along with offering efficient operation.

Obvious advantages of packaged individual motor drives are well illustrated in Fig. 8, which shows a line of 17 oil pumps in an oil refinery. Each pump is driven by a 7½ hp explosion proof motor with a gear speed reducer mounted on the same base as the motor. Pushbutton controls are conveniently mounted on frames in front of each motor. All wiring is in conduit, and the whole arrangement is neat, compact, and easy to maintain.

Mechanical transmission of power, in addition to speed reduction and speed control units, centers around belt and chain drives. Of course, the latter are particularly useful for avoiding slippage, but they are limited in absorbing sudden additions to the load. Chain drives are also sometimes advantageous

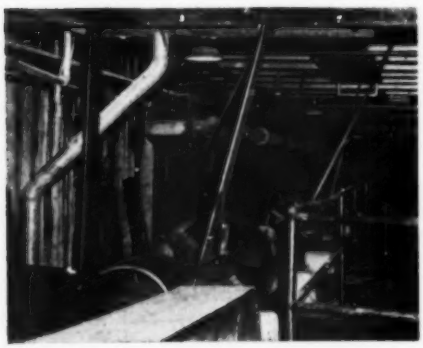


Fig. 9—Flat belts drive machines on floor above. Single motor powers the lineshaft

Fig. 10—Appearance of the belt splice for drive system on left

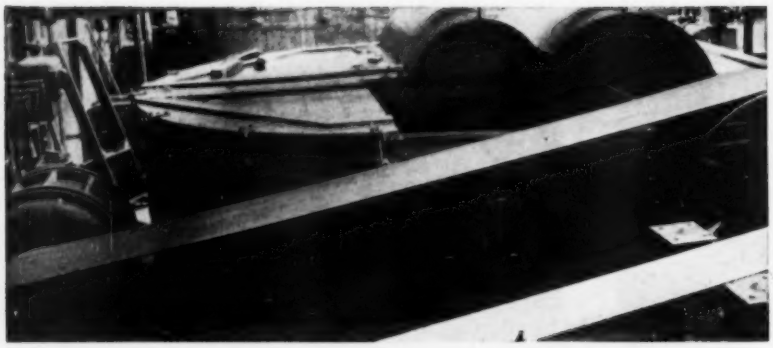


Fig. 11—This 20 in. wide, 8 ply, rubber endless belt is 38 ft 11 in. long. It transmits 100 hp in driving a beater in a paper mill. Belt ends are vulcanized

Fig. 12—Relatively small flat leather belt performs excellently on press

for heavy drives where the distance between centers is short.

Some heavy, slow speed machines are driven through a gear and pinion, which is located on the output shaft of the totally enclosed speed reducer.

The input shaft of the reducer is directly connected to the motor through a flexible coupling. This is also a positive type of drive in that it does not permit of any slippage.

Flat belts, which have been shown as part of compact drives, also fit in where compactness is not a consideration. For example, Fig. 9 shows a long lineshaft driven by a motor at the far end with rather long belts to machines on the floor above. These are rubber belts spliced endless on the job. The appearance of the finished splice is seen in Fig. 10. The plies on the two ends are stepped down to match. The gum and cement are applied, and the ends are fitted together, pressed tightly, and vulcanized with a portable electric vulcanizer. The operation is simple and when assembled carefully are practically always satisfactory. In Fig. 11 is seen an endless 20 in. wide, 8 ply rubber belt 38 ft, 11 in. long. It is for a beater drive in a paper mill and transmits 100 hp. In the first year of operation only 2 in. take up was necessary due to stretch.

Flat leather belts of course have a wide application and give satisfactory service when properly installed. Fig. 12 shows a typical application of a relatively small belt for a press drive. Very large belts are also frequently used on both long and short centers. When the distance between centers is short and the difference in diameter between driving and driven pulleys great, the motors are frequently mounted on tension control bases.

Fabric belts, sometimes with rubber between the plies, are utilized because they are flexible and can be made endless and lapless. Elimination of the lap (at the joint) is sometimes a very important factor in preventing the setting up of vibrations, especially with high speed machinery, for example, the spindles of textile winders and wood-working machinery.

In Fig. 13 is shown a typical application of multiple V-belt drives. In both cases the distance between centers is short and the speed reduction large. One machinery builder of long experience has made a very illuminating analysis of flat leather and V-belt drives. This analysis points out that flat belts pull heavy loads at low speeds that would call for more V-belts than is usually desirable. In addition the fact that flat belts fly off the pulleys, or can be knocked off quickly in case of jam makes them desirable from the safety standpoint. Where high speed, short center drives are concerned, this analysis explains, the best results are obtained by using flexible rubberized belts with the motors mounted on tension control bases. However, there are a great many cases where flat leather belts, which have been properly designed for the purpose, give excellent service under such conditions.

With relatively high speeds, short center distances and high ratios of speed reduction this company uses multiple V-belt drives and when necessary the motor is mounted on a tension control base. In some instances V-belts are used with the flat side running on a flat pulley, which is the larger one of the drive, and in sheaves for the smaller one. When using V-belts it is of first importance not to exceed the load per belt or to have sheaves of smaller diameters than specified by the belt manufacturer. When the diameter of the sheave is less than the specified minimum the belt is liable to crack and be very short lived. There are also V-belts for special purposes such as the cog belts, designed for great flexibility, and V-belts reinforced with nylon cords or steel cables for extra strength.

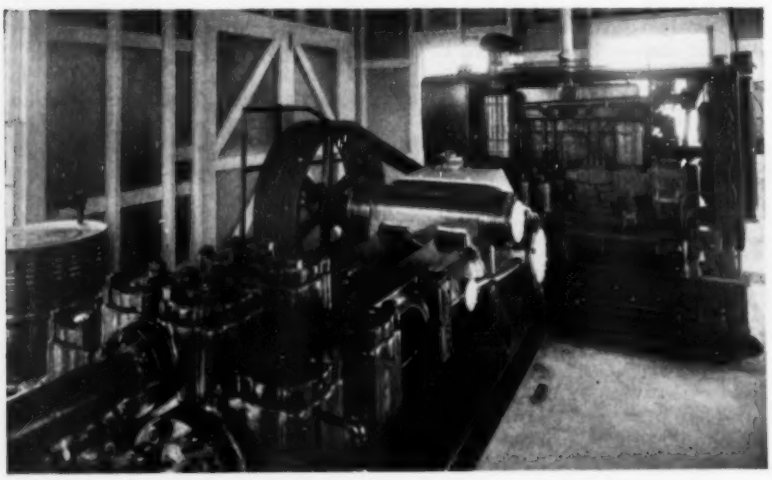
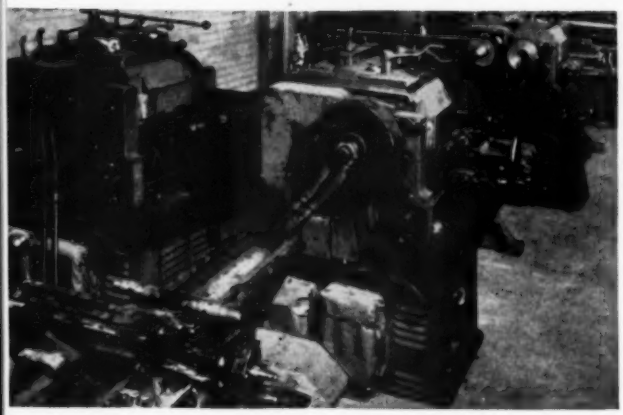


Fig. 13—Short center V-belt drives are adaptable for light or heavy loads. Unit illustrated shows the heavy duty belts connecting an engine and oil pump

DEFENSE PLANT DE-MOTHBALLED FAST WITH THE HELP OF TWO SUN PRODUCTS



BEFORE: The machinery in this Navy-owned shell-making plant stood idle—coated with a rust preventive—for 5 years after World War II. When asked to reactivate the plant in three months, the U. S. Hoffman Machinery Corporation anticipated a complete machinery teardown for cleaning, because the rust preventive had seeped into the working parts.

AFTER: No teardown was needed. Sun Spirits did the external cleaning job and the detergency of Sunvis H.D. 700 Oils the internal job—cleaning out parts and freeing hydraulic systems. Thanks to the effectiveness of these products, the job was completed and the plant put in operating condition within the three months specified by the Navy.

Recently the U. S. Hoffman Machinery Corporation was asked to reopen a World War II Navy-owned shell-making plant and start production in three months. The machinery, idle for 5 years, had been protected by an external layer of rust preventive. Headstocks, gear units and hydraulic lines were among the parts coated, and unfortunately some of the protective material had seeped into them. It looked as if the machinery might have to be torn down to be cleaned.

Hoffman invited Sun and several other oil companies to survey the machinery and suggest cleaning methods. The company chose Sun's recommendations on the basis of their soundness, as well as on Sun's record for reliable service in other Hoffman plants. The Sun products used eliminated the need for any dismantling. Sun Spirits did the external cleaning job. Sunvis H.D. 700 Oils freed up the hydraulic systems, many of which were extremely sluggish; the detergency of these oils flushed away every last trace of sludge and rust preventive.

Throughout the entire cleaning and recharging process, Sun representatives stayed on the job. As part of Sun's regular service, they trained the oilers, helped work out an inventory control system, and set up lubrication schedules. The terms of the Navy contract were met, and vital defense production was started on schedule. In the year and a half that has since elapsed, there have been no machine failures traceable to poor lubrication.

SUN OIL COMPANY, Dept. IP-4
Philadelphia 3, Pa.

☐ I would like to consult with a Sun representative.

☐ Please send me a copy of "Sunvis H.D. 700 Oils."

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TECHNICAL ASSISTANCE AVAILABLE. Sun's engineers are at your service for consultation on any matters concerning hydraulics, lubrication or metalworking. It will pay you to utilize the broad experience they have gained in solving a wide variety of lubricating and processing problems in many different industries.

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

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HOFFMAN
VACUUM PUMPS

NEW! VERTICAL MOTOR HIGH ABOVE DIRT AND WATER

If excessively hot condensate is a problem in your steam plant, this New Hoffman Vacuum Pump offers positive relief. The exclusive Jet-Type Vacuum Producer featured in all Hoffman Vacuum Pumps assures efficient operation under conditions ordinarily impossible. It is the most effective means known for simultaneously removing air and water from the system. Years of service cause no deterioration, as the Hoffman Jet has no moving parts to wear or score. As a result, *the Hoffman Vacuum Pump will handle hotter water than other types of pumping units.*

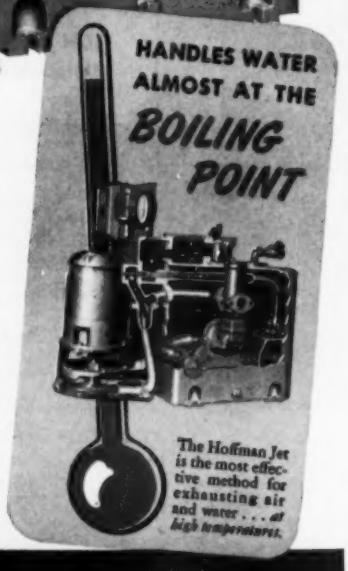
TYPES "VS" and "VSS" SINGLE UNITS
Available in duplex units

CAPACITIES:
From 2,500 to 100,000 sq. ft. EDR.

DISCHARGE PRESSURES
From 20 lbs. to 60 lbs. per sq. in.

• Bronze fitted throughout • Enclosed, precision balanced bronze impeller • Renewable bronze wearing ring • Split bronze packing gland • Stainless steel impeller hub • Impeller has top suction inlet—eliminates air or vapor binding • Rigid motor support, very quiet • Easily handles 200°F condensate.

Write today for Cat. No. VP 852, no obligation.


HANDLES WATER ALMOST AT THE BOILING POINT
The Hoffman Jet is the most effective method for exhausting air and water . . . at high temperatures.

Power Supplies

(Continued from page 89)

or rotating equipment at a relatively low rate from a three phase source. During the weld period, the energy was discharged at the high rate necessary for aluminum and other hard to weld metals.

They filled a definite gap and permitted welding even on very weak distribution systems. However, they did not provide flexibility in weld current wave shape necessary to easily avoid certain types of weld defects. They are expensive and have little advantage for low carbon steel.

Three Phase Welders

Currently, the most popular developments, both for weld quality and for easing the power supply problem, are the three phase types of welders. One, the rectifier type, employs a three phase transformer with low voltage secondary connected to a three phase, full wave rectifier, which in turn supplies d-c current to welder electrodes mounted in the conventional manner.

The frequency converter type employs a single phase welder of conventional construction except that the ratio of core iron to winding ampere turns is altered for low frequency use. Control circuits include a three phase rectifier to supply the primary winding, with provisions for reversing the current flow in the latter 10 to 24 times per second, providing 5 to 12c weld current.

In both types, effect of secondary inductance in causing high kva demand is practically eliminated. Other factors, such as rectifier losses, are introduced to limit total gain, but the actual kva reduction is large (depending on the throat depth of the single phase welder to which it is compared). In addition, the load may be distributed over three phases which further greatly reduces voltage variations. Of course, kva reduction results in increased power factor, beneficial in itself.

Welding characteristics of the three phase types are considered excellent, especially for the hard to weld metals. This secondary inductance, while having little effect on kva demand, does limit rate of rise of welding current producing a sort of automatic slope control which, however, is not completely flexible. Other characteristics, such as a "tailing current", to reduce porosity or weld hardening are easily obtained. Also since secondary impedance is low (ohmic), weld resistance is a higher percentage of the total. Weld current tends to adjust to the necessary heat input by varying inversely as the resistance, which varies with surface and electrode conditions and the like.

FIRST *complete* packaged boiler

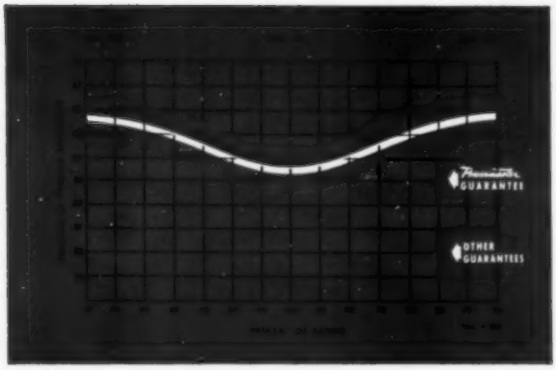
FIRST full modulating cam control

FIRST *Voriflow* air-atomizing burner

FIRST immediate change-over—oil or gas

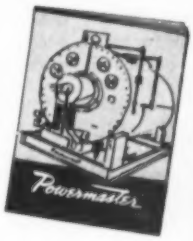
NOW—*Powermaster*® is FIRST to guarantee 83% minimum efficiency

The "pay-off" on a boiler is its operating efficiency . . . and *only Powermaster guarantees a minimum of 83%* with No. 6 oil!



Take a look at the typical efficiency curve of *Powermaster* shown here . . . then compare A.S.M.E. tests with those of any other boiler. At less than full load (which is normal in field operation) notice that *Powermaster* efficiency actually *increases.*

There's a reason for such efficiency. The *Powermaster* is the development of 68 years' experience in boiler manufacture. Continuing research and progressive engineering have resulted in *Powermaster* users being the first to benefit from major improvements in packaged boiler design.

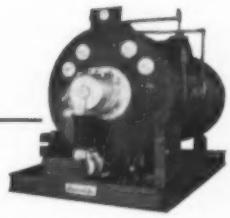


Point-by-point, *Powermaster* welcomes comparison. Before deciding on a new boiler for your plant, be sure to get the facts on the newest *Powermaster* with *Voriflow* combustion. Just drop us a line and we'll be glad to send you our new catalog.

Powermaster®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



ORR & SEMBOWER, INC. • *Established 1885* • 950 MORGANTOWN ROAD, READING, PENNA.

spot news

of what's happening in U. S. industrial plants

Representative Is Appointed for New Oxidizing Catalyst

Dravo Corp. has been appointed sales and engineering representative for Oxycat, a new oxidizing catalyst manufactured by Oxy-Catalyst, Inc. Developed by Eugene J. Houdry, pioneer in the catalytic cracking of petroleum, the new catalyst first gained recognition last May when it was installed at Enamelstrip Corp. of Allentown, Pa., to burn off noxious solvent fumes. In addition to eliminating the fumes, combustion of the gases generated enough heat energy to cut plant fuel bills by 90 per cent.

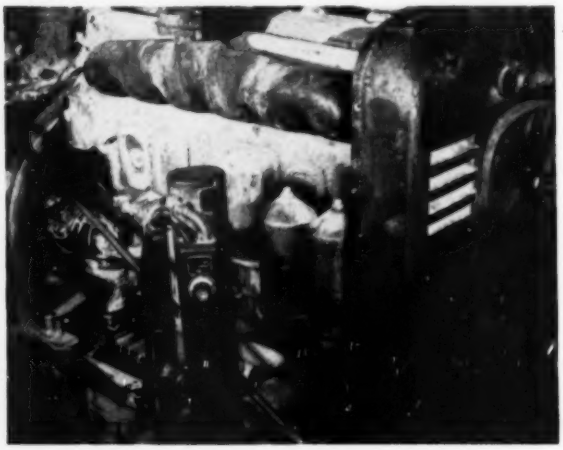
Each Oxycat unit, measuring 5½ in. long, 3⅛ in. high, and 3 in. wide, contains 73 porcelain rods coated with a .003 in. film of the catalytic agent. The units are stacked side by side and one on top of the other in exhaust stacks of furnaces, ovens, or power plants. In the illustration, a workman is shown completing the installation at Enamelstrip. Combustion of the gases occurs at the surface of the rods. The heat released usually can be recovered for useful purposes.

Dravo, through its Machinery Div., will be responsible for sales, application engineering, installation, and service in Michigan, Indiana, Ohio, Kentucky, Pennsylvania, West Virginia, Maryland, Virginia, Delaware, and New Jersey.

World's Longest Conveyer Belt Carries Coke to Blast Furnaces

What is described as the world's longest, single-flight, rubber and fabric constructed conveyer belt was recently put into operation between the coking plant and blast furnaces at U. S. Steel's new Fairless Works in Morrisville, Pa.

Built by Goodyear Tire & Rubber Co., the belt measures 5500 ft from center of the head pulley to center of the tail pulley. It hauls quenched, sized, and screened coke from the coke plant screening station to storage bins at the blast furnaces. The coke weighs 30 lb per ft on the belt, and registers temperatures of approximately 250 F. The belt moves at 300 fpm, and has a capacity rate of 400 ton per hr.



Electric Heaters Keep Engines Ready To Operate in Cold Weather

Diesel engines used in cranes, switch-engines, trucks, and other equipment used outdoors, can be safely kept ready to operate in the coldest weather with electric heat. Buffalo Slag Co., Lackawanna, N. Y., reports substantial savings of man and equipment hours ordinarily lost while waiting for engines to warm up, by the use of electric circulation heaters on three cranes and a switching engine.

These heaters, manufactured by Edwin L. Wiegand Co. under the trade name Chromalox, are a completely packaged

(Continued on page 106)

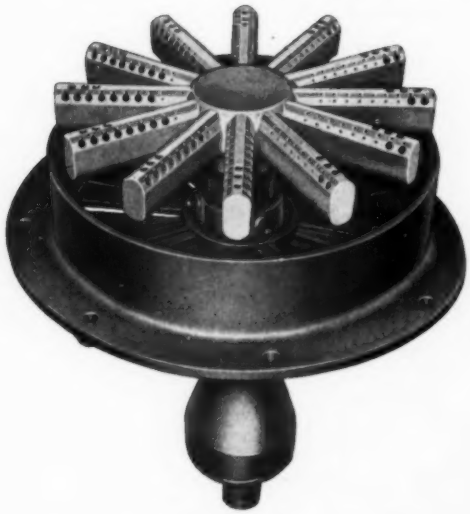
The Cover--Aurora Gasoline Co.

To prove the point that their plant is free of vapors resulting from gasoline cracking, the Aurora Gasoline Company sent along this four color cover.

The story of how they have met the problem of removing these vapors before discharging to the atmosphere is contained in "Waste Disposal in Urban Areas," by Francis C. Moriarty and Max M. Fischer, and it appears on page 83 of this issue. The four color shot was taken by Harry J. Erickson, one of the company's enthusiastic amateur photographers.

JZ JOHN ZINK CO.

FLOOR-FIRED BURNERS



Highest Heat Release per Cubic Foot of Furnace Volume.....

SERIES VBM

A short flame burner of plain, sturdy construction, the JOHN ZINK VBM VERTICAL BI-MIX BURNER for floor firing gives more heat units per cubic foot of furnace volume—provides extremely even distribution of heat in the furnace and can be used in either wet bottom or dry bottom boilers.

Easy to install, **the VBM is normally supplied in sections of two radiating armed spiders with each spider having its own individual mixer—twice mixing the air and gas; first in the atmospheric mixer; second, by the radiating arm jets of the spreader.**

Where pressures of 5 pounds or more are available, the JOHN ZINK VERTICAL BI-MIX BURNER will fire boilers and stills at extremely high ratings in small furnaces and with a low draft. *Any gaseous fuel* may be burned, such as refinery gases, natural gas, oil vapor or mixtures without port stoppage. The burners are not damaged by slugs of water, oil or gasoline blowing through or over them. These features combined with ease of control completely eliminate operating difficulties.

ALSO AVAILABLE FOR COMBINATION FIRING

Another JZ Heat Maker

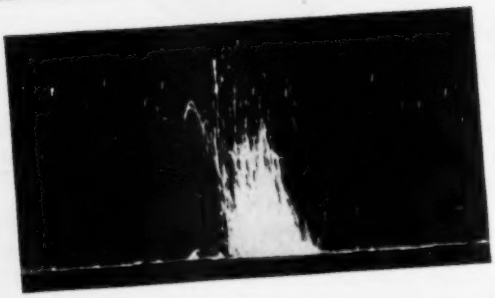
JOHN ZINK CO. 4401 SO. PEORIA AVENUE TULSA, OKLAHOMA

How Dearborn Helps

with FILMEEN for the control of return line corrosion

Dearborn's patented FILMEEN—a filming-type amine treatment—forms a continuous monomolecular film in the return line, thus effectively coating and protecting the line against both oxygen and carbon dioxide corrosion. Improves heat transfer and reduces steam costs.

Bulletin 5013-A gives complete information on FILMEEN—describes and illustrates how to reduce maintenance expense and protect valuable equipment.



with DEARBORN Formula 659

Boilers, feed lines, heaters and economizers are protected against sludge accumulations—steam purity control is assured—turbine deposits are effectively prevented—with Dearborn's Formula 659 Sludge Conditioner and Polyamide Anti-Foam Treatment. Safeguards against carry-over of suspended and dissolved solids. Protects valuable parts—avoids expensive maintenance and unnecessary shutdowns. Bulletin 5008 tells the complete story.

Dearborn

TRADE MARK

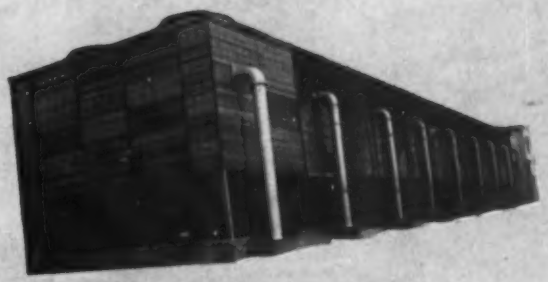
COMBATTING CORROSION EVERYWHERE SINCE 1887

DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois

Make Water Behave!

COOLING WATER for testing jet aircraft engines is treated by DEARBORN

Here is one of the giant 500,000 gallon cooling water towers operated by the National Advisory Committee for Aeronautics. To prevent scale formation, corrosion and delignification of the wood, properly conditioned water was necessary. Dearborn engineers did the job... analyzed the raw water, and specified the correct treatment, test equipment and controls.



ENGINEERED equipment

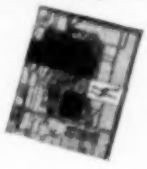
For optimum water conditioning, proper equipment is essential. Here, too, Dearborn can help you. The complete line of Dearborn ion-exchange and treatment feeding equipment, plus test control facilities, will provide you with assurance of top operating efficiency.

with DEARBORN'S complete water treatment and engineering service

Providing trouble-free water—a vital necessity to every user of steam—has been Dearborn's business for more than 65 years.

Today, this broad background of experience—plus treatment formulas that have been tested and re-tested and the most modern laboratory and research facilities—is available to you at Dearborn.

To keep your power and steam-producing facilities at peak production... to greatly minimize unnecessary maintenance—call your Dearborn Sales Engineer. He's our expert who will check your facilities—analyze your raw water—recommend the proper treatment, feeding equipment and test procedure. Dearborn Bulletin 5000 describes this service.



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☐ Have a Dearborn Sales Engineer call

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...Meet all State and Municipal Sewage Waste Disposal and Stream Pollution Regulations

Now there is a real solution to the problem of screening solids out of manufacturing waste water *before* it reaches the main sewage disposal outlets. SWECO Separators will screen from 90% to 100% of all solids from waste liquids on a production basis through screens from 50 up to 325 mesh. SWECO Separators are doing a job in the following and many other industries:

PULP & PAPER	LUMBER
TEXTILES	CHEMICALS
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Send for catalog and name of your nearest SWECO *Sales Engineer.*

SEPARATOR DIVISION
SOUTHWESTERN ENGINEERING COMPANY
4800 Santa Fe Avenue, Los Angeles 58, Calif.
Dept. IP S-9

spot news

(Continued from page 102)

unit with built-in elements, heating chamber, thermostat, and threaded inlet and outlet. They are attached to the engine block with angle irons. Flexible connections to the cooling system are used for circulating antifreeze, by natural convection, through the heater and engine block. Special pumps are not required. The illustration shows one of the heaters attached to a crane engine.

According to the manufacturer, on average winter mornings a 150 F setting is sufficient to heat most engines in a half hour. In colder weather, the heaters may be run all night at 90 F.

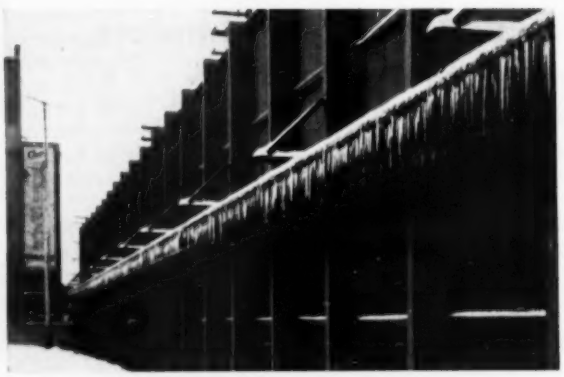
Homogeneous Reactor Produces Electricity From Nuclear Energy

Production of useful amounts of electric power by nuclear energy has been achieved from the successful operation of a new type of reactor at Oak Ridge National Laboratory. The reactor, described as an homogeneous liquid-fuel type, was developed at the laboratory, which Union Carbide and Carbon Corp. operates for the Atomic Energy Commission. It uses a single homogeneous solution to serve as fuel, moderator, and coolant. Heat, generated by nuclear reaction of uranium in the solution, is removed by pumping the hot liquid through a heat exchanger to produce steam.

In the experiment, the system was brought up to its full heat output capacity, equivalent to 1000 kw. Steam was then switched to a turbine-generator and approximately 150 kw of electrical energy was produced.

The unit at Oak Ridge, capable of producing both fissionable material and electric power, is the first to operate at a temperature and power high enough to produce steam for operating a standard industrial turbine. It must be emphasized, however, that the unit was not designed to economically produce electric power, and that many problems still remain to be solved. Experimental work will continue with higher electrical output to acquire data regarding the feasibility of this type for full-scale commercial operation.

(Continued on page 108)



ICICLES FORM ON STEAM PIPE

Under the ice, 363 F steam is flowing through pipelines of the Toledo Edison Company's Detroit Ave. heating plant in Toledo. The pipes are covered with 2¼ in. of Owens-Corning Fiberglas molded pipe insulation

STOWE Stoker

DOUBLES OUTPUT OF OLD BOILER

Restokering a 545 H.P. boiler increases output from 18,000 to 40,000 Lbs./Hr. using the same coal—with a minimum of downtime—and expense.

• The fastest way to get more steam—and the cheapest—is to restoker one of your present boilers with a Stowe Stoker.

FOR EXAMPLE

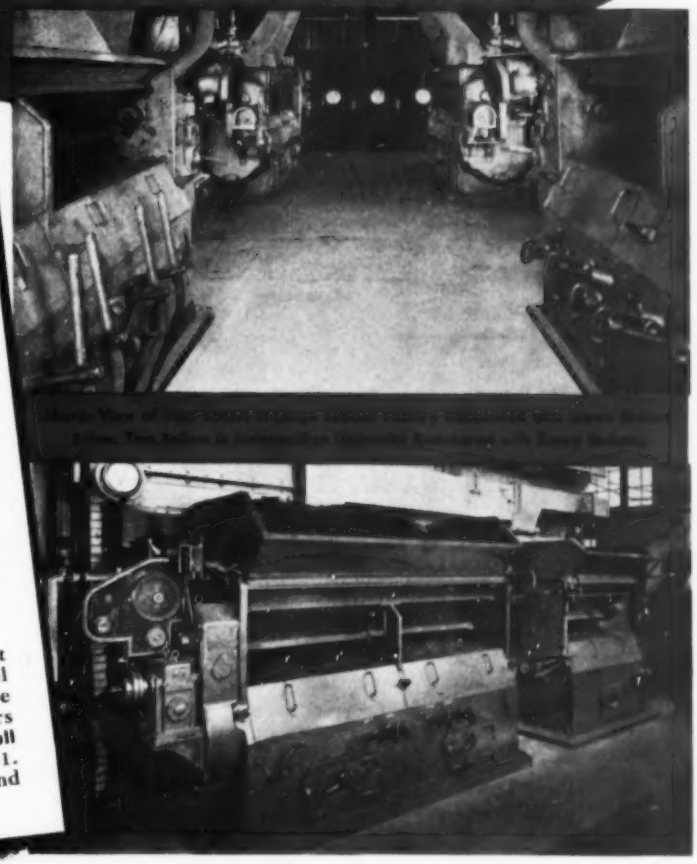
A LARGE TIRE FACTORY restokered one boiler with a Stowe Stoker, doubling its output—then restokered 3 more—is now getting 60,000 lbs. more steam from the same 4 boilers.

A LARGE ENGINE MANUFACTURER restokered one boiler with a Stowe Stoker—doubled its output—and has since installed Stowe Stokers under four more old, and three new boilers.

A METROPOLITAN UNIVERSITY restokered a small 300 H.P. boiler, saved $9,000 in coal costs the first heating season and has since restokered a 500 H.P. boiler and bought one more Stowe for a new boiler.

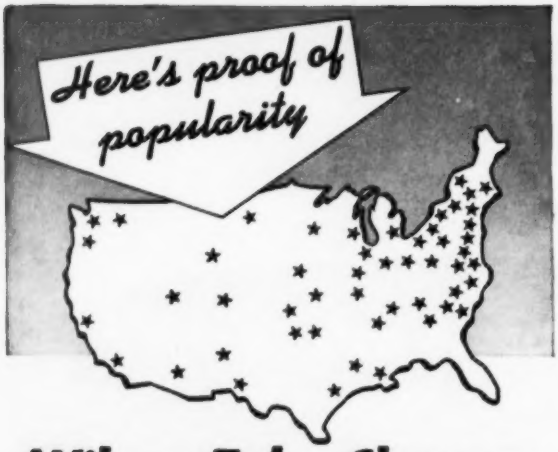
HERE'S WHY

High burning rates per sq. foot of grate area—even depth of fuel bed and uniform air distribution are some of the reasons Stowe Stokers perform so well. Why not get **full details**. Write for Bulletin No. 501. It tells **what** Stowe Stokers do—and **why** they are able to do it.



STOWE Stokers

Manufactured by THE JOHNSTON & JENNINGS CO. • 6917 Bessemer Avenue • Cleveland 27, Ohio
.... *Division of* PETTIBONE MULLIKEN CORP...



Wilson Tube Cleaners and Expanders are EVERYWHERE

For more than a quarter of a century, precision made Wilson tubular maintenance equipment has been serving American industry. Today, Wilson Tube Cleaners and Expanders are as near as your telephone. They are cutting downtime and saving maintenance costs in industrial and power plants all over the United States . . . and the world, too.

WILSON TUBE CLEANERS handle every kind of deposit—hard or soft, thick or thin or variable in depth. Powerful, fast-acting, they make quick work of cleaning straight or curved tubes from ⅛" to the largest ever cleaned. Wide range of cutter heads and accessories available.

WILSON TUBE EXPANDERS offer smooth, efficient rolling action which insures firm seating of the tube . . . provides perfectly rolled joints . . . reduces time-wasting re-rolling and re-inspection.

Yes, Wilsonize to economize. Follow the lead of thousands of industrial plants throughout America. Send for 48-page Bulletin on complete Wilson Tube Cleaner line and for Tube Expander Catalog. A single request brings both.

Representatives in all principal cities
THOMAS C. WILSON, INC.
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WILSON

TUBE CLEANERS • TUBE EXPANDERS

spot news

(Continued from page 106)

Experiment Proves Feasibility of Transporting Coal by Pipeline

Pipelines may someday be used to transport coal from mine to market, just as gas and oil are now handled. Two years ago, in order to prove the feasibility of such a system, Pittsburgh Consolidation Coal Company earmarked more than a half million dollars to build a demonstration size coal pipeline system near Cadiz, O. The project consisted of a 12 in. line approximately 17,000 ft long, special crushing and slurry preparation equipment, and specially designed pumps. The coal is pulverized and mixed with water to form a slurry. It must then be dried at the end of the pipeline before delivery to customers.

Latest comment on the experiment was in the company's annual report, which said: "After 8 months operation, the experimental project in Ohio has provided sufficient data to satisfy us that transmission of coal by pipeline can be developed economically. The product is esentially coal in a new form, and we are now proceeding to develop the commercial aspects of providing sales outlets for it.

Manufacturer Exhibits Cast Iron That Will Twist and Bend

Cast iron that will bounce on impact instead of breaking, and will twist and bend, was one of the features displayed by the International Nickel Co., Inc., at the Western Metals Exposition in Los Angeles, March 23-27.

Known as Ductile Iron, it was first made available commercially in 1949, when the year's total production was 3500 tons. This jumped to about 100,000 tons in 1952. Basically, it is gray iron to which a small amount of magnesium and nickel has been added. The new metal, in effect, is a new engineering material that bridges the gap between iron and steel.

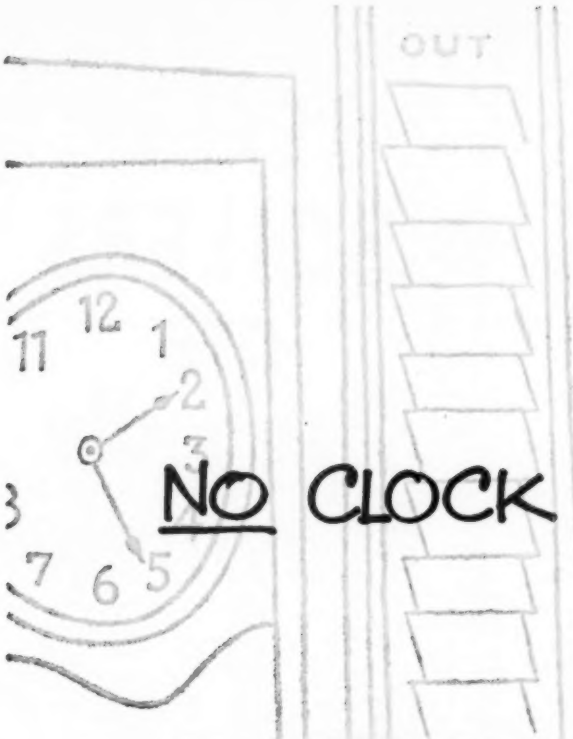
In addition to being ductile, the material is reported to be wear and heat resistant. Company research engineers have listed over 500 established and 200 experimental applications. Uses are found in almost every branch of industry from petroleum refining to pump construction.

Coal-Burning Gas Turbine Closer to Commercial Use

Development of the coal-burning gas turbine will be given an added boost by a contract between Bituminous Coal Research, Inc., and the American Locomotive Co. Under this agreement, Alco will carry on development of the turbine for commercial applications, and design a chassis for locomotive use. The program will be jointly carried out with BCR's Locomotive Development Committee.

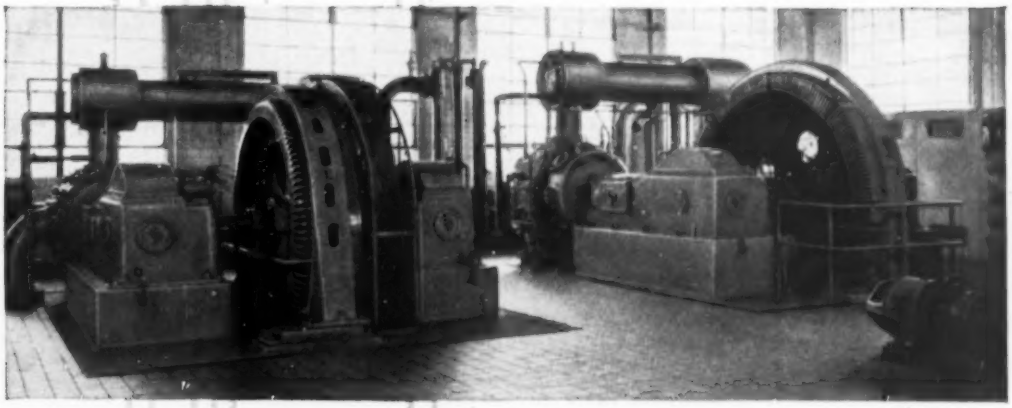
Researchers for the committee, representing nine major coal-carrying railroads and five of the nation's largest coal companies, began work on the coal-burning gas turbine in 1945. An extensive high temperature test program was completed recently at Alco's Dunkirk, N. Y. plant, with bituminous coal being used exclusively to fuel a 4250 hp turbine of a type contemplated for locomotive use.

—End



NO CLOCK PUNCHING

for these compressors



That's right! There's no daily time limit placed on the work output of Chicago Pneumatic Class O-CE Compressors . . . they operate "around the clock" with a minimum of attention. Designed for continuous, year-in, year-out heavy industrial usage, these units are unsurpassed for a dependable air power supply at low cost. Built in sizes up to 2,000 hp, for pressures up to 5,000 lbs., they are available in horizontal, two-stage, water-cooled types with direct-mounted synchronous motor drive.

The Chicago Pneumatic Class O-CE Compressor is equipped with roller bearings, Simplate valves for low power consumption, streamlined air passages to cut down air flow resistance, CP Multi-Step Control for partial load economy, and a CP Intercooler for maximum heat transfer and low water consumption. Ask for Bulletin 726. *Chicago Pneumatic Tool Company, 8 East 44th Street, N.Y. 17, N.Y.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

LEFFEL BOILERS are Ruggedly Beautiful—

and you can depend on them

VAN DYNE-CROTTY COMPANY
2340 RICHARD ST. ★ DAYTON 3, OHIO ★ PHONE: KENMORE 5178

KEX

The James Leffel & Company
Springfield, Ohio

Gentlemen: Attention: Mr. A. G. Lebold

At the present time, in our power plant, we have two Leffel Oil Fired Boilers. One is a 100 H.P. unit, the other is a 150 H.P. unit. We have the 100 H.P. Boiler as a standby unit in case of an emergency, and we are happy to say that the operation of the 150 H.P. Boiler has been so successful that we have never had to use the standby.

The 150 H.P. Leffel Boiler is operated five days a week, and at the present time is pulling as high as 270 H.P., with excellent results. Since the time of installation we have had no repairs on this outfit.

We have always considered the LEFFEL Boiler the best that is obtainable.

Yours very truly,

Chas J Kuntz

Chief Engineer
THE VAN DYNE CROTTY CO.

Bridges, buildings and other load-bearing structures are designed with 100% overload capacity. A boiler should be so designed, too.

All the chrome and red paint in the world won't help if you need power above your boiler's rated capacity and can't get it.

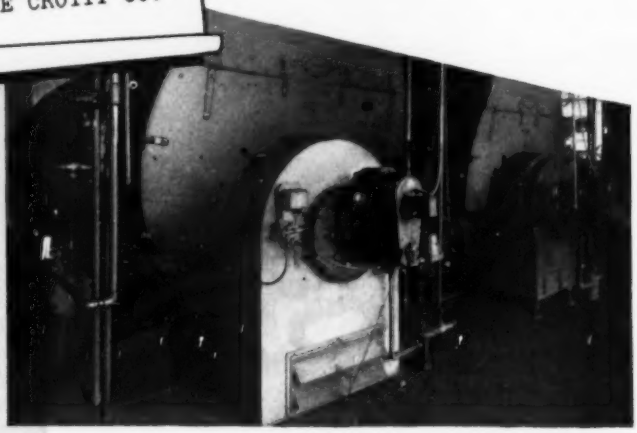
Streamlined boiler design won't keep your production up if your boiler has a tendency to break down.

A boiler rated close to its peak capacity usually has corners trimmed elsewhere. No help in an emergency. Strains to reach rated performance.

You can depend on Leffel boilers. **Look at the second paragraph in the letter above. Ask about a Leffel boiler wherever you find it. You'll find it's hardly noticed, because it has done its job, and more, however old it is, with a minimum of attention.**

The integrity of Leffel has never been lowered—*not once*—during the entire 91 years of our history.

If you want a boiler you won't worry about, fired by coal, gas or oil, drop us a line.



The boiler room at Van Dyne-Crotty contains a 150 H. P. Leffel boiler, ***actually*** delivering up to 270 H. P., shown in the foreground—and a 100 H. P. Leffel Scotch boiler next to it.

Sheet 10-30-52

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPT. C, SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT STEAM GENERATION FOR 91 YEARS

HOT LIME–AMBERLITE IR-120...

An Economical Method for Treating Boiler Feedwater

The use of AMBERLITE IR-120 cation exchange resin following the hot lime process eliminates the need for soda ash and sharply reduces phosphate requirements in the treatment of boiler feedwater. Results:

1. **Lower operating costs**—The cost of salt regenerant for AMBERLITE IR-120 is very much lower than the cost of soda ash and phosphate.
2. **High quality feedwater**—High capacity AMBERLITE IR-120 yields water of virtually zero hardness regardless of fluctuations in influent water composition. The resin permits use of excess lime, which results in steam having lower carbon dioxide.
3. **Long trouble-free service**—AMBERLITE IR-120 is stable toward heat, alkali, and acid.
4. **Simplification**—Smaller space is required for AMBERLITE IR-120 exchanger units than for second stage phosphate settling tanks. Only one chemical—lime—is used in the hot process.

For more complete information about economical feedwater treatment with AMBERLITE IR-120, write Dept. P-2. For bi-monthly reports on new developments in ion exchange, ask to receive AMBER-Hi-LITES. No obligation.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

AMBERLITE *is a trademark, Reg. U.S. Pat. Off. and in principal foreign countries.*

new books

of special interest

Heat Transfer

"Heat Transfer Phenomena" by R. C. L. Bosworth, Associated General Publications Pty, Ltd., distributed by John Wiley & Sons, Inc., 212 pages, $6.00.

In August, 1948, the Australian Branch of the Institute of Physics held a conference on heat transfer at Sidney. The material used at this conference has been expanded and presented by R. C. L. Bosworth in a volume published by an Australian firm. Dr. Bosworth writes clearly on a difficult subject. He even makes the Stefan-Boltzmann Law understandable and reasonably logical. Furthermore, the material is recent and deals in a practical way with the conduction of heat in gases, radiative transfer, conduction in solids and liquids, forced and natural convection, and heat flow with simultaneous phase change.

The volume is worth examining in that it will bring a technical library up to date on heat transfer phenomena.

Electric Motors

"Control of Electric Motors," Third Edition, Paisley B. Harwood, John Wiley & Sons, Inc., 538 pages, $7.50.

Harwood is Vice President in Charge of Engineering, Cutler-Hammer, Inc. and a Fellow, American Institute of Electrical Engineers. His book, "Control of Electric Motors," is well known by engineering readers in its two previous editions. This third edition includes a great deal of new information on circuits, devices, and calculations used for the regulation of voltage, speed, and tension. It presents numerous industrial applications and gives clear and concise descriptions of electronic amplifiers, rotating regulators, and positioning servomechanisms. There is a new chapter on the basic principles of automatic regulating systems.

The edition, like the last, is arranged by motor types. It begins with a general discussion of wiring diagrams, construction details, and pilot devices as applied to all kinds of motors. It then moves into two sections, one on d-c motors and motor control and the other on a-c motors and their control.

Different?

...Ask:

Cincinnati Gas & Electric • Public Service Co. of Northern Illinois • Commonwealth Edison Co., Calumet Station • Arkansas & Missouri Power Co., Campbell, Mo. • Southwestern Public Service Co., Amarillo, Texas • U. S. Atom Bomb Plant, Oak Ridge

More than 65,000 sq. ft. of Klemp Diamond Riveted Grating at The Cleveland Electric Illuminating Co., Eastlake Plant, Eastlake, Ohio.

As usual...

KLEMP STAIR TREADS and DIAMOND RIVETED GRATING meet industry's strictest requirements

Architects and engineers throughout the world definitely recognize the unvarying high quality of KLEMP Diamond Riveted Grating. In evidence, witness the fact that approximately 70% of our business consists of repeat orders. For down-to-earth facts on how and why this grating truly is *different*, mail coupon immediately.

KLEMP METAL GRATING CORPORATION
Executive Office: 1371 N. Branch Street, Chicago 22, Illinois
Plants and Warehouses at Chicago, Illinois and Houston, Texas

We Tread the World with Safety

FREE booklet!

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1371 North Branch Street, Chicago 22, Illinois
Please substantiate your statement that Klemp Gratings are DIFFERENT.

Name_____
Title_____
Company_____
Local Address_____
City_____ Zone____ State_____ IP-4

meetings

and exhibitions

APRIL

April 10-11, **Michigan Engineering Society,** annual meeting, Kellogg Center Hotel, Michigan State College campus, East Lansing, Mich.

April 14-16, **Conveyor Institute,** conducted by the University of Illinois Dept of Mechanical Engineering in cooperation with the Conveyor Equipment Manufacturers Association, Illini Union Building on the U. of I campus, Champaign, Ill.

April 22-24, **American Institute of Electrical Engineers,** Southern District meeting, Hotel Seelbach, Louisville, Ky.

April 28-30, **The American Society of Mechanical Engineers,** spring meeting, Deshler-Wallick Hotel, Columbus, O.

April 29-May 1, **American Institute of Electrical Engineers,** North Eastern District meeting, Sheraton Plaza Hotel, Boston.

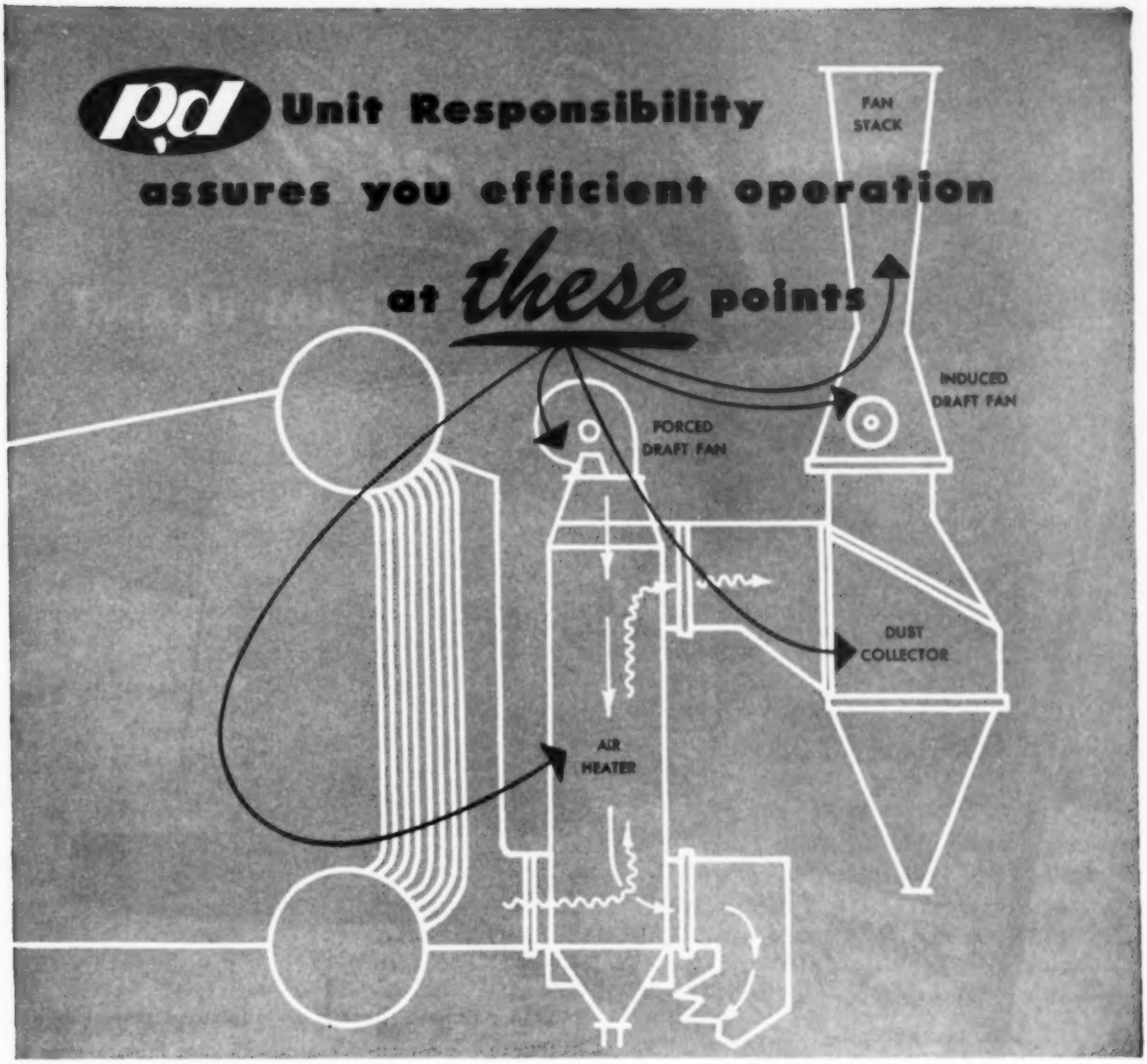
MAY

May 4-6, **Compressed Air & Gas Institute,** King & Prince Hotel, St. Simons Island, Ga.

May 10-15, **American Water Works Association, Inc.,** annual national convention, Grand Rapids, Mich.

May 11-13, **Heat Exchange Institute,** The Greenbriar, White Sulphur Springs, W. Va.

May 25-27, **Hydraulic Institute,** Seaview Country Club, Absecon, N. J.



Unit Responsibility, for important components of plant design by the Prat-Daniel Corporation, relieves your engineers of necessary problems of coordination that often arise when equipment is purchased from several sources.

Prat-Daniel, designing and manufacturing engineers of *Forced Draft Fans*, *Air Preheaters*, *Tubular Dust Collectors*, *Induced Draft Fans* and *Fan Stacks*, make possible this coordination of components by a single company with over a quarter of a century experience in the power field.

This service is offered through The Thermix Corporation, project engineers for Prat-Daniel. Specialists in this field, they can assure you a completely integrated system. Why not contact Thermix today. Ask for the new P-D Bulletin 4P201.

Project Engineers for Power Plant Division

THE THERMIX CORPORATION

GREENWICH, CONN.

(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD., Montreal 25, Quebec; Toronto 5, Ontario

Designers and Manufacturers

PRAT-DANIEL CORPORATION

SOUTH NORWALK, CONN.

POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks.

HERE'S YOUR *Complete* STEAM PLANT

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.
- For complete details, write today for catalog **502.**

SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES, Inc.

Factory: Emmaus, Pa.

Executive Offices: Times Building, Times Square, New York 18, N. Y.

3 *special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in*

ENGINEERED PLANT SERVICES

1. NEW EQUIPMENT

Begins on page 8

Contains highlights of new products by leading manufacturers, briefed and illustrated for your easy reference. Complete data on each of these products are available ***free***.

2. NEW BULLETINS

Begins on page 130

Includes descriptions of only those bulletins and catalogs that are really ***new*** and of ***direct value*** to you — saves your reading time, yet gives you full service. All bulletins sent to you ***free*** on request.

3. READERS GUIDE TO ADVERTISED PRODUCTS

Begins on page 117

Designed to catalog advertised products for your convenience in finding the ads which are of special interest to you at this time. Also lists those important bulletins, catalogs and working data offered ***free*** in the advertisements.

REQUEST CARD FOR LITERATURE OR MORE INFORMATION—April, 1953

To: INDUSTRY AND POWER, St. Joseph, Mich. Please have forwarded to me, at no obligation, the literature I've indicated by the following key numbers:

New Equipment begins Page 8	*New Bulletins begins Page 130*	*Advertised Products begins Page 117*
No's_____	No's_____	No's_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Your Name_____ **Title**_____

Your Company_____

Co. Address (St. & No.)_____

City_____ **State**_____

Inquiries for items in this issue not serviced beyond August 1, 1953

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_____	_____	_____
_____	_____	_____

Your Name_____ **Title**_____

Your Company_____

Co. Address (St. & No.)_____

City_____ **State**_____

Inquiries for items in this issue not serviced beyond August 1, 1953

readers guide

to advertised products

AIR & DUST FILTERS & COLLECTORS

Key No. 500—Rapping system of Cottrell precipitators is described in Bull FA. Research Corp. p 42.

Key No. 501—Booklet, "The Collection and Recovery of Industrial Dusts." Buell Engineering Co. p 56.

Aerotec series mechanical-electrical dust collectors are described on p 34. The Thermix Corp.

Key No. 502—Coupon on p 120 offers brochure on Aeroturn Series 12 dust collector. Turner & Haws Engineering Co., Inc. p 120.

BOILERS & BOILER ACCESSORIES

Descriptive literature available on Wickes steam generators. The Wickes Boiler Co. p 149.

See adv. p 21 for information on C-E vertical unit boilers. Combustion Engineering-Superheater, Inc.

Adv. p 134 describes Kewanee steel boilers. Kewanee-Ross Corp.

Key No. 503—Bulletin, "Wrought Iron For Flue Gas Conductors and Coal Handling Equipment." A. M. Byers Co. p 39.

Adv. p 110 contains information on Leffel boilers. The James Leffel & Co.

Key No. 504—Boiler auxiliaries, from outlet to stack, are described in P-D Bull 4P201. The Thermix Corp. p 113.

BUILDING HEATING, VENTILATING, AIR CONDITIONING & REFRIGERATION

Full details available on Trane ventilating heaters. The Trane Co. p 41.

Key No. 505—Data on Vano design "A" ventilator. Coupon on p 25 lists special uses of blowers. Coppus Engineering Corp.

BUILDING MATERIALS & MAINTENANCE

Key No. 506—Free Repair Handbook describes Smooth-On repairs. Smooth-On Mfg. Co. p 148.

Key No. 507—Coupon on p 112 offers data on Klemp diamond riveted grating. Klemp Metal Grating Corp.

Key No. 508—Coupon on p 147 offers complete details of trial order plan of floor patch and Handbook of Building Maintenance. Flexrock Co.

Key No. 509—Free handbook on commutator and slip ring maintenance offered in coupon on p 143. Ideal Industries, Inc.

Key No. 510—Electroforged steel grating is described in Bull 2365. Blaw-Knox Div., Blaw-Knox Co. p 147.

Key No. 511—Free sample of Key graphite paste and pipe joint compound offered on p 144. Key Company.

COAL, ASH & BULK HANDLING

Key No. 512—Bull 300 contains data on G-W basic designs of coal handling. Gifford-Wood Co. p 64.

Canton coal firing, handling, and control equipment is described on p 62. Canton Stoker Corp.

Key No. 513—Facts and case histories available on Marietta concrete storage tanks. The Marietta Concrete Corp. p 139.

Key No. 514—Dings magnet or magnetic separator for tramp iron problems is described in Bull C-5000-B. Dings Magnetic Separator Co. p 127.

(Continued on page 118)

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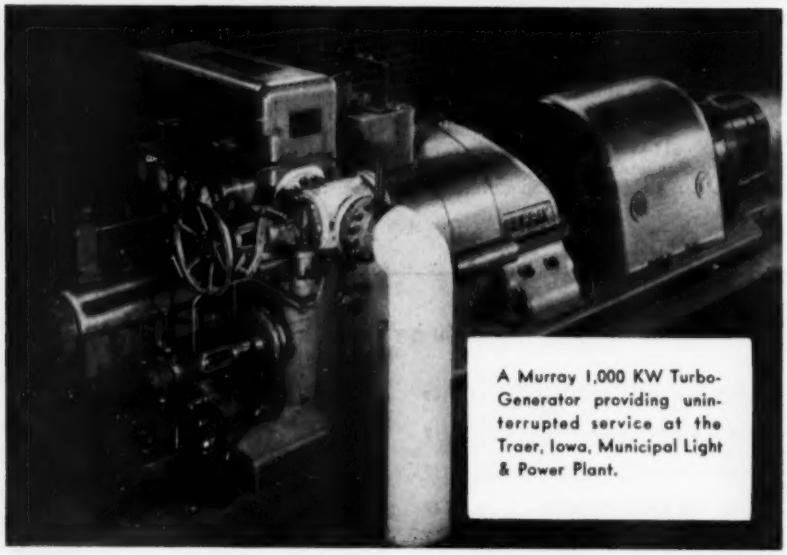
Murray Turbines



A Murray 1,000 KW Turbo-Generator providing uninterrupted service at the Traer, Iowa, Municipal Light & Power Plant.

A typical, modern, small public utility is the Municipal Light and Power Plant at Traer, Iowa. This plant supplies water, steam heat and electric power to the community and surrounding countryside. The Murray turbo-generator pictured above carries the full electric load of the plant and supplies the steam for heating by automatic extraction at 10# gauge pressure.

The simplified design and rugged construction of this and all MURRAY turbines particularly adapt them to this or any other drive where long life, reliability and low operating costs are a MUST.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

readers' guide

to advertised products

(Continued from page 117)

COMPRESSORS

Key No. 515—Class O-CE compressors are described in Bull 726. Chicago Penumatic Tool Co. p 109.

Adv. p 9 contains information on Cooper-Bessemer motor-driven compressors. The Cooper-Bessemer Corp.

CONTROLS, REGULATORS & INSTRUMENTS

Key No. 516—Details available on Liquidometer tank gage. The Liquidometer Corp. p 148.

Key No. 517—Bulletins available: power factor meter (GEC-901); testing instruments (GEC-830); Type CF-1 recorder (GEC-215). General Electric Co. p 38.

Key No. 518—Accritem regulators for water temperature control are described in condensed Cat 3035. The Powers Regulator Co. p 127.

Key No. 519—Full information on Hays Miniscale gages is described in Bull 52-1075-223. The Hays Corp. p 63.

Key No. 520—Literature available on Jerguson non-frosting gages. Jerguson Gage & Valve Co. p 123.

Key No. 521—Available questionnaire or Cat 600-14 on self-operated temperature regulators. Sarco Co., Inc. p 59.

Key No. 522—Literature available on Weston all-metal thermometers. Weston Electrical Instrument Corp. p 125.

Key No. 523—Bulletin contains full details on Spence pressure and temperature regulators. Spence Engineering Co. p 54.

ELECTRICAL DISTRIBUTION

Key No. 524—Bull 5301 gives full details on Type OD-2 selective overcurrent trip device. I-T-E Circuit Breaker Co. p 28, 29.

Key No. 525—"How to Reduce Power Costs and Gain System Capacity", booklet GEA-5632. General Electric Co. p 36.

Key No. 526—Data on circuit breakers is described in Bull 3101. Heinemann Electric Co. p 122.

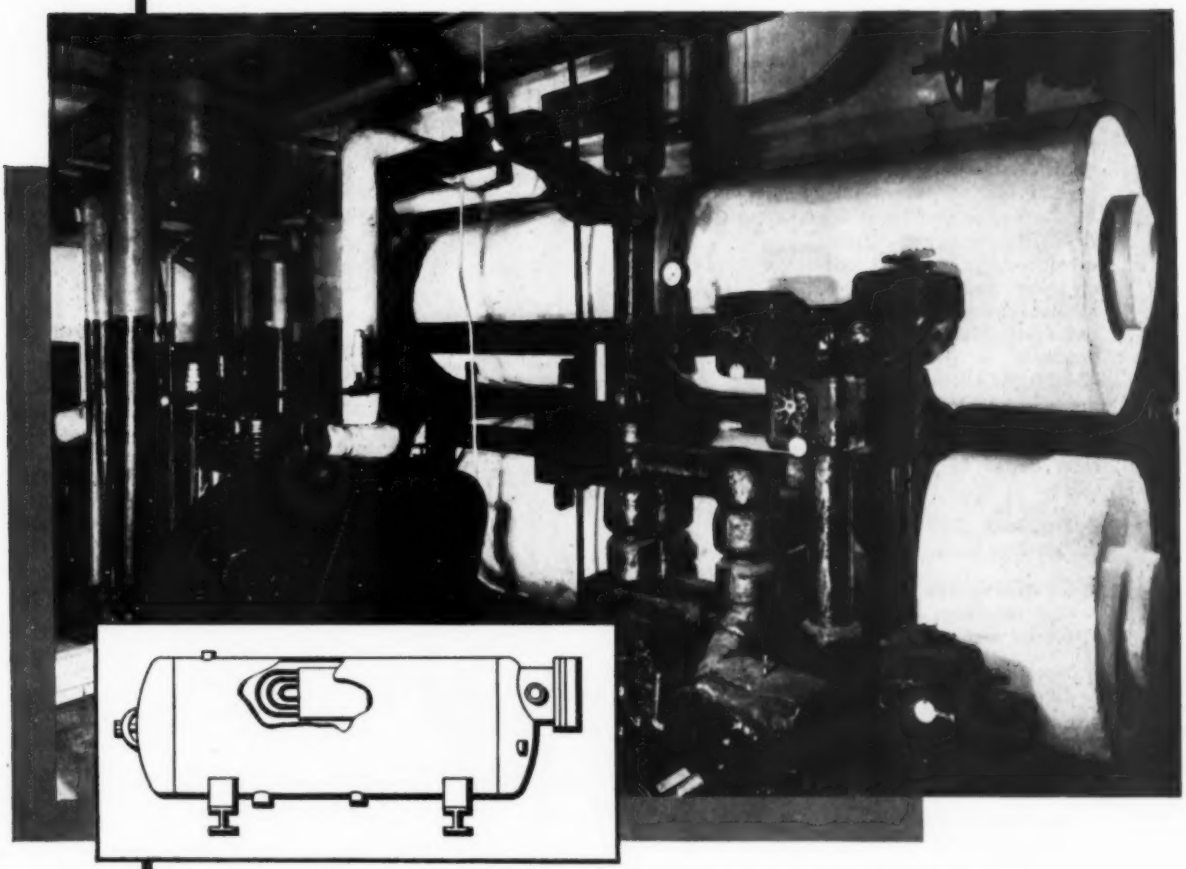
ELECTRICAL HEATING UNITS

Key No. 527—Bulletin contains complete data on Chromalox radiant panel. Radiant Heating Div., Edwin L. Wiegand Co. p 43.

(Continued on page 120)

keep up with the Times

pipe cold drinking water to all working areas from a p-k storage water chiller



Fresh, chilled drinking water is efficiently supplied to all 17 floors of the New York Times building in New York by means of a new p-k combination water storage tank and built-in chiller.

With this design, smaller chilling surface and refrigerator compressor capacity can be used and the load factor is improved. Individual water coolers are dispensed with and concentration of cooling facilities in one central location reduces initial investment and facilitates servicing. Fluctuating water requirements are easily met without temperature change. Any new or present compressor equipment can be used.

p-k storage water chillers are available in many sizes and in various kinds of materials to suit individual requirements. These same storage cooler units are applicable to any liquid cooling application, in process and other industrial plants.

Write today for illustrated literature and engineering suggestions. Ask for Catalog No. 101.

the Patterson-Kelley Co., inc.

1140 Burson St., East Stroudsburg, Penn.

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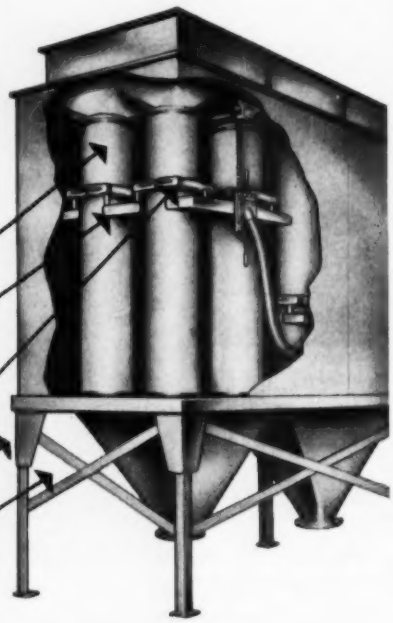
101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities

IT'S NEW!

AEROTURN "On The Job"

. . . the SERIES 12 Dust Collector

AEROTURN is proud to announce its NEW series 12 Dust Collector, the result of eight years of intensive research and successful application in more than 40 industries. Produced under Hersey Patent Rights and pioneered by the Turner and Haws Engineering Co., Inc. of Boston, AEROTURN is industry's most advanced, automatic, self-cleaning dust collector. A high volume air cleaning rate at a substantial, dollar-saving economy is produced by AEROTURN'S fully automatic, pressure regulated, reverse-air-jet cleaning operation.



NEW Series 12 features include:

- ★ Standard 12" diameter felt filter bags.
- ★ Completely new designed cast aluminum blow ring carrier assembly.
- ★ Improved automatic, self-adjusting blow rings.
- ★ Overall reduction in size of collector unit.
- ★ Standardized overall design featuring pre-assembled units for reduced installation time and costs.

Whatever your dust collection problem, including reclamation of filtered material, you'll find that an AEROTURN Dust Collector will meet your needs successfully and economically. To learn more about the NEW Series 12 Collector, simply fill in the coupon below and mail, or a T & H Representative will call at your request.

TURNER & HAWS Engineering Co., Inc. 87 Gardner St. Boston

☐ Please send me a copy of your Series 12 Brochure

☐ Have Representative Call

Name_____

Address_____

City_____ Zone____

State_____

B 12

readers' guide

to advertised products

(Continued from page 118)

FANS & BLOWERS

Key No. 528—Coupon on p 2 offers centrifugal blower Cat B-10 with complete data. Hartzell Propeller Fan Co.

FILTERS, STRAINERS & PURIFIERS

Adv. p 126 contains information on Elliott twin strainers. Elliott Co., Accessories Dept.

Key No. 529—Bulletin contains prices and data on Armstrong Y-Type strainers. Armstrong Machine Works. p 144.

Key No. 530—Bulletin contains data on Flo-Klean filters. Cuno Engineering Corp. p 45.

FUELS & FIRING EQUIPMENT

See adv. p 14, 15 for information on bituminous coal. Bituminous Coal Institute.

Adv. p 30, 31 contains information on Riley "50" pulverizer. Riley Stoker Corp.

Adv. p 103 contains data on John Zink series VBM floor-fired burners. John Zink Co.

Key No. 531—Catalog 501 contains descriptive data on Stowe stokers. The Johnston & Jennings Co. p 107.

Information on Bell & Zoller coals. Bell and Zoller Coal Co. p 65.

Adv. p 135 contains information on coals. General Coal Co.

Key No. 532—Free booklet, "Efficient Coal Utilization." Southern Coal Co., Inc. p 18, 19.

Key No. 533—Bulletin describes Enco oil and gas burner units in sizes to suit all capacity requirements. The Engineer Co. p 58.

Adv. p 57 gives information on perfect spread stokers by American Engineering Co.

Key No. 534—Coupon on p 121 offers Petro catalog of commercial-industrial oil and gas-oil firing equipment. Petro Division.

Key No. 575—Catalog 101 contains complete data on the new p-k combination water storage tank and built-in chiller. Patterson-Kelly Co., Inc. p 119.

HEAT EXCHANGER EQUIPMENT

Key No. 535—Typical installations of Vogt film type exchangers are described in Bull HE-7. Henry Vogt Machine Co. p 53.

Key No. 536—Bulletin contains information on Niagara Aero After Coolers. Niagara Blower Co. p 133.

(Continued on page 122)

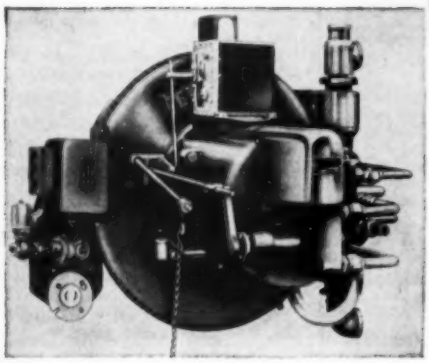
NO MATTER WHAT THE DEMAND

THERE'S A

Petro

INDUSTRIAL OIL BURNER

to handle it!



Shown above Model WA for use with cold oil.
Also available Model W-AH for use with heated oil.

Model G-W Combination oil-gas.

Cut Fuel Costs with Heavy Fuel Oil

Petro rotary oil burners are built for firing all types of boilers up to 600 boiler horsepower, and also for many other industrial applications. They are designed to burn the low-cost, heavy fuel oils with complete reliability, Petro oil burners slash fuel costs two ways—they burn the *lower priced oils*, and they do it with *outstanding efficiency*. Fluctuating steam demands are answered automatically with Petro modulating flame control. Thousands of owners will tell you that Petro Industrial Oil Burners are fuel savers, labor savers and trouble savers, and their dependability is traditional.

Your heating contractor can tell you about Petro burners. Turn to "Oil Burners" in telephone book yellow pages. See catalog in Sweet's Architectural File, or mail coupon below.

INDUSTRIAL—COMMERCIAL—RESIDENTIAL
An oil burner for every need

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50 Years of Leadership in
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Please send me the Petro catalog of commercial-industrial oil and gas-oil firing equipment.

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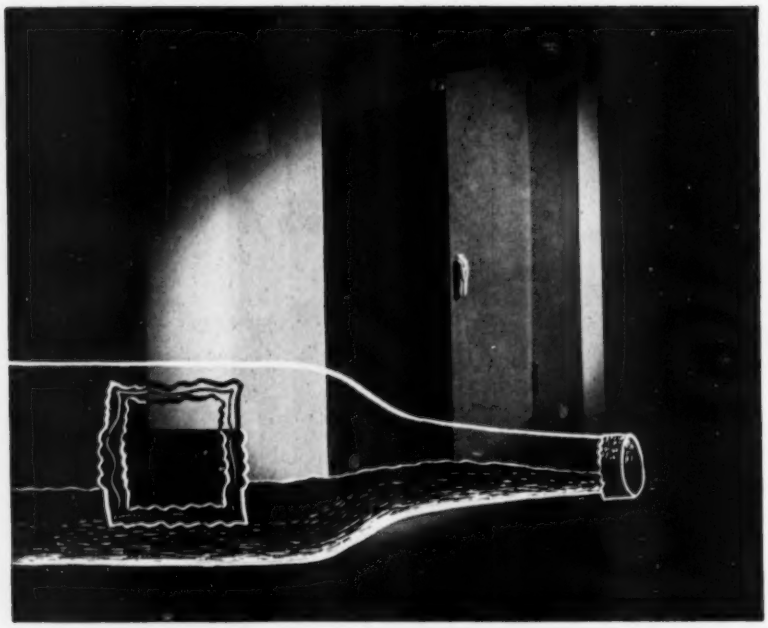


Your panelboard may be your bottleneck

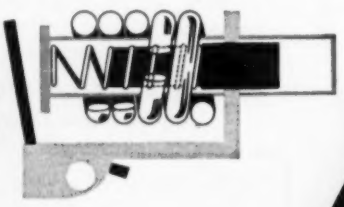
YOUR branch circuits may be wired for 30 or 50 amperes, but do you *really* get that power through your panelboard? Do you have frequent power interruptions during periods of high production . . . particularly in hot weather?

Plant engineers are breaking this nuisance bottleneck by replacing with HEINEMANN Circuit Breakers. The current carrying capacity of HEINEMANN Circuit Breakers does not vary with temperature; nor do the set tripping points. De-rating is never necessary . . . 50 amperes means 50 amperes of usable capacity in your branch circuits. There is never nuisance tripping with the accompanying costly production delays.

HEINEMANN Circuit Breakers operate on a hydraulic-magnetic principle. They provide inverse time delay to allow for starting inrush and harmless, momentary overloads . . . yet they provide the fastest circuit interruption available on large overloads or short circuits.

HEINEMANN Circuit Breakers pay for themselves in another way, too: They have low wattage loss which reduces the current consumption in the panelboard itself . . . a considerable long-term saving.

don't use heat ...USE POWER



Write for Bulletin 3101.

HEINEMANN ELECTRIC CO.

140 PLUM STREET • TRENTON 2, NEW JERSEY

readers' guide

to advertised products

(Continued from page 120)

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Key No. 537—Free publication "Genius At Work" describes Kroil for loosening frozen parts. Kano Laboratories. p 147.

Key No. 538—Specific bulletin and free, testing sample of Non-Fluid Oil. New York & New Jersey Lubricant Co. p 143.

Nonpareil turbine oil is described on p 35. Standard Oil Company.

Rubilene oil for diesel lubrication is described in adv. p 51. Sinclair Refining Co.

Key No. 539—Literature describes complete line of Hilco purifiers, filters, reclaimers and conditioners. The Hilliard Corp. p 6.

Key No. 540—Full information available on Manzel forced feed lubrication. Manzel, Inc. p 123.

Key No. 541—Literature on "Sunvis H. D. 700 Oils" is offered in coupon p 99. Sun Oil Company.

MATERIALS OF CONSTRUCTION

Key No. 542—Reference manual, "Engineering Properties of 'K' Monel and 'KR' Monel." The International Nickel Co., Inc. p 44.

MECHANICAL POWER TRANSMISSION

Adv. p 3 contains information on Hy-T V-belts by Goodyear Tire & Rubber Co., Mechanical Goods Div.

Key No. 543—Catalog and handy selector charts available on Lovejoy flexible couplings. Lovejoy Flexible Coupling Co. p 139.

Key No. 544—Condor Whipcord belts are described in Bull 6869. Raybestos-Manhattan, Inc., Manhattan Rubber Div. p 47.

Adv. p 4 contains information on Goodrich grommet belts. The B. F. Goodrich Co., Industrial & General Products Div.

Information on Hyatt roller bearings is given on p 50. Hyatt Bearings Div., General Motors Corp.

Available literature describes solid steel collars. Hallowell Power Transmission Div., Standard Pressed Steel Co. p 144.

Adv. p 33 contains data on Gates Vulco ropes. The Gates Rubber Co.

MOTORS & GENERATORS

Key No. 545—G-E boiler feed pump

(Continued on page 124)

More Accurate Level Reading of LOW TEMPERATURE LIQUIDS . . .

JERGUSON

Large Chamber

NON-FROSTING* GAGES

YOU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

Here's a dual feature gage that assures greatly increased accuracy of reading for the process industries. If you have a problem with light gaseous fluids, or with gage frosting, it will pay you to investigate the new Jerguson Large Chamber Non-Frosting Gage . . . reflex or transparent.

Jerguson Large Chamber Gage, Transparent Type, with the patented Non-Frosting Gage Glass Extension. Write for literature on this gage, and on other non-frosting Jerguson models.

**Patented*

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

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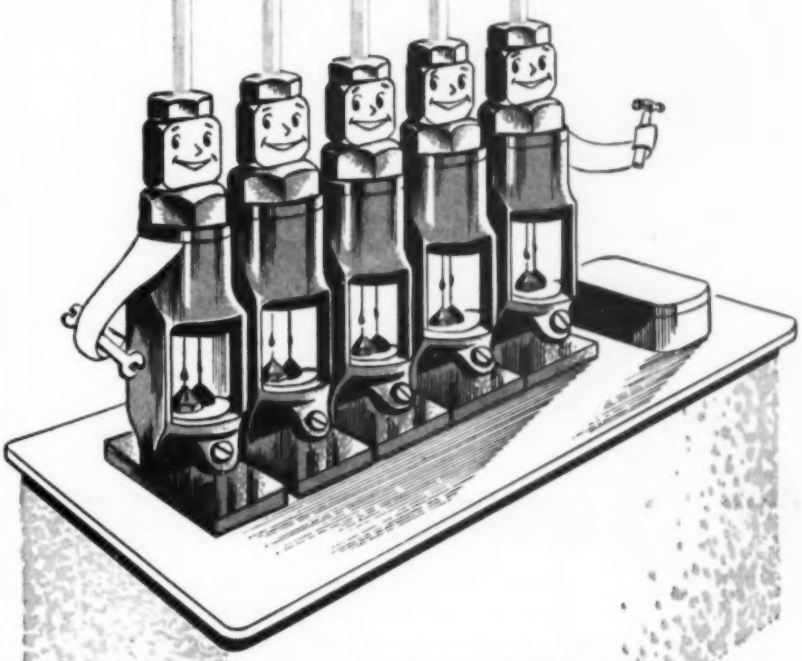
Manzel's

MECHANICAL MAINTENANCE MEN

- SAVE LABOR
- REDUCE WEAR
- PREVENT BREAKDOWNS
- SLASH OIL CONSUMPTION
- ELIMINATE DOWNTIME



Automatic force feed lubrication by Manzel provides a sure way to *lengthen* the life of machinery and reduce operating costs. Manzel Lubricators unfailingly supply *exactly* the amount of oil needed at each wearing point *and no more.* They are furnished as standard equipment on leading makes of engines and machinery, or they can be installed on your present equipment. Write now for full information.

Manzel

320 Babcock Street
Buffalo 15, N. Y.

DART UNIONS don't get tight, stay tight because of an ordinary "jammed" joint. Their tightness comes from a precision-ground, bronze-to-bronze ball joint that comes apart readily and remakes repeatedly — as tight as when new.

Both seats are non-corrosive bronze for top protection against pitting and corrosion. Nuts and both ends are high test, air refined malleable iron — practically indestructible in use or abuse.

Remember, the *extra* work life of a Dart is money in your pocket! Darts can be installed and reinstalled, time after time, with absolute assurance of tightness.

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART
UNIONS

readers' guide

to advertised products

(Continued from page 122)

motors are described in Bull GEA-5813. General Electric Co. p 37.

PACKAGED STEAM GENERATORS

Key No. 546—Catalog gives facts on Powermaster packaged boiler with Voriflow combustion. Orr & Sembower, Inc. p 101.

Key No. 547—Information on the Econotherm boiler is contained in Bull EC-52B. Hapman-Dutton Co., Dutton Boiler Div. p 131.

Key No. 548—Complete details on Superior packaged steam generators are described in Cat 502. Superior Combustion Industries, Inc. p 114.

PACKING AND GASKETS

Key No. 549—Illustrated catalog contains data on Crane Super Seal packing. Crane Packing Co. p 142.

J-M packings are described in adv. p 49. Johns-Manville Corp.

Adv. p 10, 11 contain information on R/M's Big 7 packing types. Raybestos-Manhattan, Inc., Packing Div.

PIPE, TUBING & HOSE

Key No. 550—Cat EJ-1912 contains data on gun-pakt expansion joints. Yarnall-Waring Co. p 22, 23.

Key No. 551—Bulletin contains specifications on Flexon expansion joints. Flexonics Corp. p 40.

Adv. p 124 contains information on Dart unions. Dart Union Co.

Key No. 552—Folder "Flexineering" contains details on Penflex flexible tubing. Pennsylvania Flexible Metallic Tubing Co., Inc. p 46.

PUMPS

Vertical turbine pumps are described in adv. p 27. Worthington Corp., Vertical Turbine Div.

Key No. 553—Descriptive literature available on Hills-McCanna "U" type metering and proportioning pumps. Hills-McCanna Co. p 137.

Key No. 554—Condensed Catalog "M" contains information on Aurora pumps. Aurora Pump Co. p 144.

De Laval centrifugal pumps are described on p 52. De Laval Steam Turbine Co.

Key No. 555—Data on Hoffman vacuum pumps is contained in Cat VP 852. Hoffman Specialty Mfg. Corp. p 100.

REFRACTORY CONCRETES

Information available on Super ₡3000 refractory cement. Refractory & Insulation Corp. p 141.

SOOT BLOWERS & TUBE CLEANERS

Key No. 556—Tube expander catalog and 48-page bulletin describes Wilson tube cleaner line. Thomas C. Wilson, Inc. p 108.

Tube expansion control system described in adv. p 136. Airetool Mfg. Co.

Ideal tube expanders are described in adv. p 135. The Gustav Wiedeke Co.

STEAM SPECIALTIES

Key No. 557—Bull 35 contains data on Illinois steam traps. Illinois Engineering Co. p 148.

Key No. 558—Coupon p 150 offers book "Solving Steam Trap Problems". The V. D. Anderson Co.

Yarway impulse steam traps are described on p 66. Yarnall-Waring Co.

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 115. For quick reference to free literature offered by advertisers in this issue, refer to listing on page 128. Our Reader's Service Department will handle your request promptly.

THERMAL INSULATION

Key No. 559—Coupon on p 129 contains complete data on Black Rockwell insulating materials. Baldwin-Hill Co.

Key No. 560—Free book available on "Kaylo Heat Insulation." Owens-Illinois Glass Co., Kaylo Div. p 55.

TOOLS

Adv. p 135 contains data on Skinner valve and bibb reseater. M. B. Skinner Co.

Key No. 561—Industrial and general catalogs describe Snap-On wrenches and hand tools. Snap-On Tools Corp. p 132.

Key No. 562—Coupon on p 146 offers free literature on masonry and concrete saws. Clipper Mfg. Co.

TURBINES

Worthington steam turbine generators are described on p 26. Worthington Corp., Steam Turbine Div.

Key No. 563—Data on Terry solid-wheel turbine is contained in Bull S-116. The Terry Steam Turbine Co. p 60.

Adv. p 118 contains information on the Murray turbo-generator. Murray Iron Works Co.

(Continued on page 126)

All Metal THERMOMETERS

with WESTON dependability built-in

The heart of the modern, dial-type thermometer is the all-metal temperature element. Developed over 15 years ago, the WESTON all-metal element has plenty of proof behind it. In fact, the dependable accuracy of this unit has made the readable WESTON thermometer favorite for laboratory use as well as for all industrial temperature needs. For *extra* dependability, specify WESTON all-metal thermometers . . . available in the types, ranges and sizes indicated below. Literature available. WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.

Type	Scale Length	Ranges		Stem Length		% Accuracy of Therms. Range
		As low as	As high as	As short as	As long as	
Heavy Duty Straight Form	9"	−100F	+1000F	2½"	48"	1
Heavy Duty Angle Form	9 or 12"	−100F	+1000F	2½"	72"	1
Standard Angle Form	6"	−100F	+1000F	2½"	72"	1
General Purpose	4½"	−100F	+1000F	2½"	36"	1
Laboratory	3.46"	−100F	+500F	2"	24"	½ of 1

WESTON Instruments

799

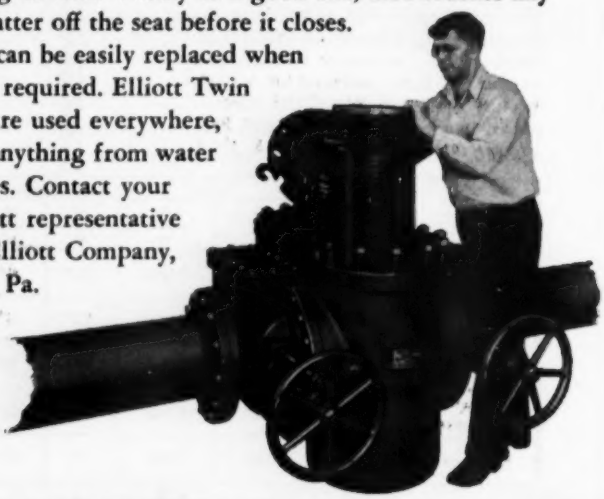
There's no "do it now" about cleaning an

ELLIOTT TWIN STRAINER

No need to interrupt some vital maintenance job to dump the fouled basket on one of these non-stop straining units. The alternate basket will take on the job with the turn of a couple of handwheels, cutting out the fouled basket for attention any convenient time within a reasonable period.

Not that cleaning is so much a job. It isn't—all that's necessary is to back off the cover nuts a few turns, spin out the washers, lift the cover, pull out the basket, dump it, and reverse the process. That basket is open at the top, too, for easy dumping. No fussing to get out the trapped trash.

TWIN STRAINERS have a number of features to help them keep on the job. Valve discs, for instance, have an inserted rubber ring as wear-worthy as a good tire, that brushes any foreign matter off the seat before it closes. This ring can be easily replaced when ultimately required. Elliott Twin Strainers are used everywhere, handling anything from water to molasses. Contact your local Elliott representative or write Elliott Company, Jeannette, Pa.



ELLIOTT Company

Accessories Dept.

A3-2

readers' guide

to advertised products

(Continued from page 125)

VALVES

Adv. p 143 describes rubber-lined metal valves with manual or automatic control. W. S. Rockwell Co.

Key No. 564—Bull 100-A contains data on David No. 13 automatic pressure reducing valves. Davis Regulator Co. p 139.

Key No. 565—Strong single-seated, pilot-controlled valve is described in Cat 68-X. Strong, Carlisle & Hammond Co. p 129.

Everlasting valves are described in adv. p 140. Everlasting Valve Co.

Key No. 566—Full details and prices available on Chapman tilting disc valves. The Chapman Valve Mfg. Co. p 61.

Key No. 567—Literature is available on the new Crane-Paul valve. Crane Co. p 7.

Key No. 568—Catalog gives 4 ways to cut pump repairs. Sims Pump Valve Co., Inc. p 148.

WATER TREATMENT

Key No. 569—Available ASME paper "Correlation of Silica Carry-over and Solubility Studies." National Aluminate Corp. p 13.

Key No. 570—Free technical paper No. 98 "Boiler Scale—Its Formation and Prevention". W. H. & L. D. Betz. p 17.

Key No. 571—Bull V-11 contains data on H&T water softeners or demineralizers. Hungerford & Terry, Inc. p 147.

Key No. 572—Coupon on p 128 will bring complete details on the Chlorinizer slime control system. Builders-Providence, Inc.

Elgin water conditioning systems for every need are described on p 48. Elgin Softener Corp.

Key No. 573—Feedwater treatment with Amberlite IR-120 described in report Amber-Hi-Lites. Rohm & Haas Co. p 111.

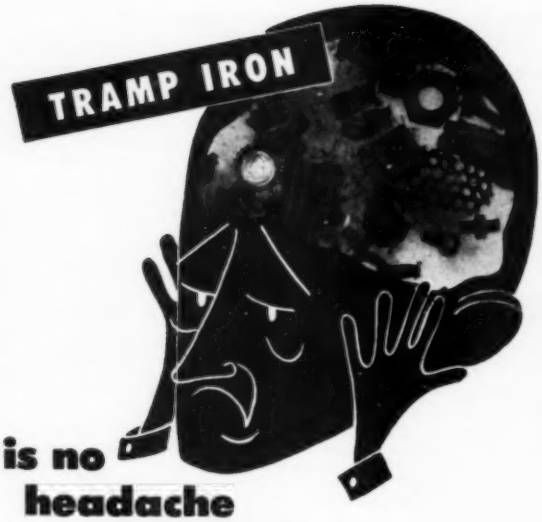
Key No. 576—Catalog describes Sweco separators for screening solids from waste liquids. Separator Div., Southwestern Engineering Co. p 106.

Key No. 577—Coupon on p 105 offers bulletins on filming-type amine treatment, polyamide anti-foams, water treatment and engineering service. Dearborn Chemical Co.

MISCELLANEOUS

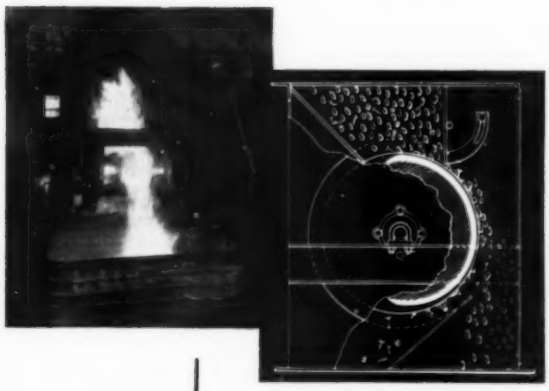
Key No. 574—Coupon on p 138 offers free book on the Apeco Auto-Stat that produces dry photocopies automatically. American Photocopy Equipment Co. p 138.

—*End*



is no headache with DINGS Perma-Drums

POWERFUL, non-electric Dings Perma-Drums and Drum type Separators can pull out tramp iron before it causes production headaches. They're easily installed in chutes or ducts, and the tough, armor-plate drum shell handles dry, wet or flaming hot material (below, left). Stationary Perma-Drum Alnico Magnets use no current, lose no magnetic strength, are guaranteed for the physical life of the unit.



how they work

1 Tramp Iron held fast to drum shell by magnetic pull.

2 Non-magnetics flow over shell in normal trajectory.

3 Tramp Iron is discharged separately when it passes out of magnetic field.

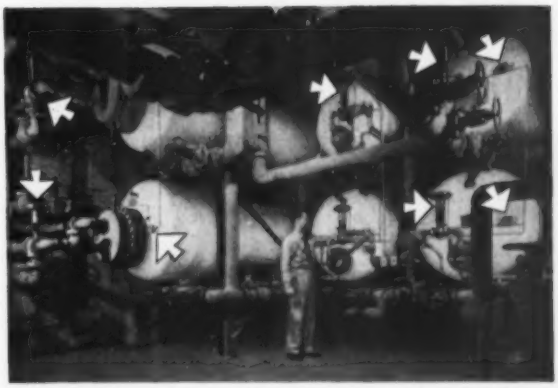
DINGS RECTANGULAR SUSPENDED MAGNETS

DINGS MAGNETIC PULLEYS

There's a Dings Magnetic Separator for every tramp iron problem — *write* DINGS MAGNETIC SEPARATOR CO., 4736 W. Electric Ave., Milwaukee 46, Wisconsin for BULLETIN C-5000-B *today.*

FD 153

DINGS Magnets



Water Heaters Controlled by Powers Accritem Regulators

What's Your Water Temperature Control Problem?

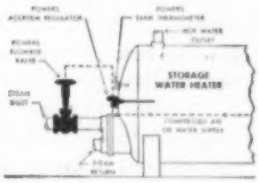
POWERS ... with their many types of thermostatic regulators and 60 years experience is well qualified to help you find the right type of control for these applications:

Forced Hot Water Heating Systems; various types of Water Heaters and Heat Exchangers; Jacket Water Cooling for Air Compressors, Diesel and Gas Engines also Cyclotrons, Chocolate Enrobers and Plastic forming Presses; all types of Shower Baths and Hospital Hydrotherapy; processing X-Ray, Regular and Colored Film — and hundreds of other uses.

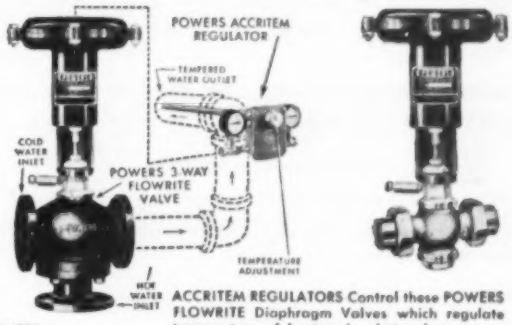
Only one of Powers varied line of water temperature controls is shown here ... the *Accritem Regulator.* It's compressed air operated, has calibrated dial temperature adjustment, adjustable sensitivity and many other features described in *Condensed Catalog 3035.*

Compressed Air Operated

Only one of many applications Small Size. Bulb is 12" long



Powers Accritem Regulators Give Years Of Dependable Service



(a92)

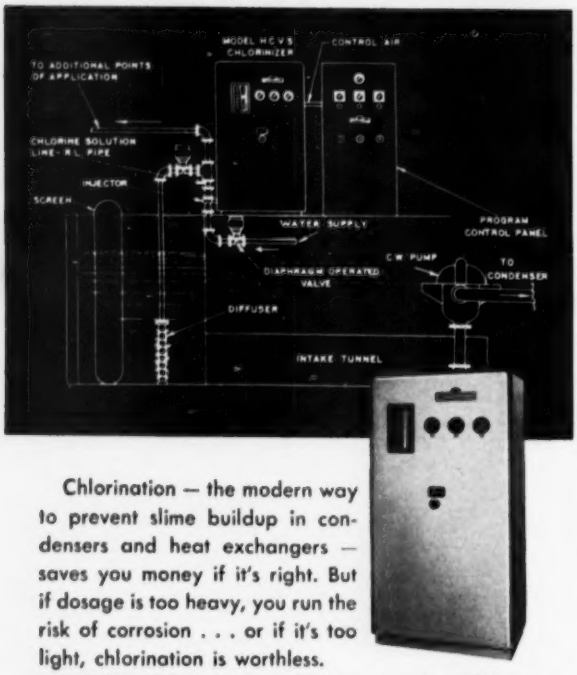
ACCRITEM REGULATORS Control these POWERS FLOWRITE Diaphragm Valves which regulate temperature of heaters in photo above.

THE POWERS REGULATOR COMPANY

Skokie, Ill. • Offices in Over 50 Cities, see your phone book.

OVER 60 YEARS OF WATER TEMPERATURE CONTROL

Slime Control IN COOLING SYSTEMS



Chlorination — the modern way to prevent slime buildup in condensers and heat exchangers — saves you money if it's right. But if dosage is too heavy, you run the risk of corrosion . . . or if it's too light, chlorination is worthless.

Builders Chlorinizer is the key to safe, effective, economical chlorination in cooling systems. CHLORINIZER IS ACCURATE . . . The sensitive compensating valve and the visible-flow Sightflo Indicator guarantee correct feed for effective treatment and insure against corrosion. CHLORINIZER IS SAFE . . . The full vacuum principle automatically and positively shuts off chlorine feed on loss of vacuum. CHLORINIZER IS SIMPLE . . . Because of its basic design, Chlorinizer is readily adaptable to single or multiple point applications on manual, semi-automatic, or fully automatic control.

Builders Chlorinizers are available in three volumetric models for feeding from a few pounds to 6,000 pounds per day. Send coupon for complete details.

BUILDERS-PROVIDENCE, INC.

(DIVISION OF B-I-F INDUSTRIES)

357 Harris Avenue, Providence 1, Rhode Island

Please send Application Memo No. 840-J9 describing Chlorinizer slime control system.

Name.....

Company.....

Street.....

City.....State.....

quick reference

to bulletins & catalogs

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NOTE — List "Key Numbers" on the postal card on page 115

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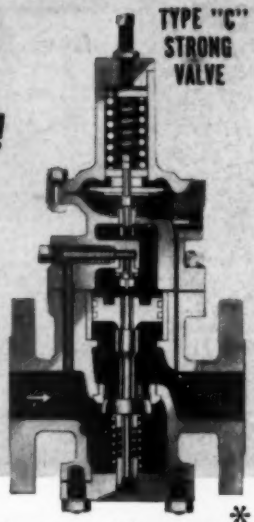

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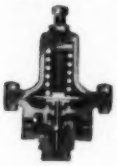

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new bulletins

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BUILDING MATERIALS & MAINTENANCE

200—Vacuum Cleaning System

Operation of a central vacuum cleaning system, for industrial and institutional applications, is discussed in 20-page booklet D-5. Component parts, including exhauster unit, separators, piping system, and attachments, are presented. Basic engineering information is included to make it possible to plan a system in complete detail. Billmyre Blower Div., Lamson Corp.

BOILERS & BOILER ACCESSORIES

201—Jet-Tray Deaerators

Operation of jet-tray type deaerators is discussed in 4-page folder 400A. A cutaway view shows construction. Function, design, application, and outstanding features also are discussed. American Water Softener Co., Inc.

AIR & DUST FILTERS & COLLECTORS

202—Dust Control Equipment

Dust control equipment for foundries is the subject of revised 28-page brochure 1152. Latest information, installation photos and diagrams of multi-wash collectors, hoods, and cupola collectors are presented. Claude B. Schneible Co.

203—Tubular Dust Collectors

Problems of fly ash collection are discussed in 8-page brochure 4P201. Tubular dust collectors are described, and efficiency curves, arrangements, and standard dimensions are presented. Flue gas density tables, and a formula and nomograph for calculating the number of tubes required for any volume and resistance, are presented to aid in selecting dimensions for a unit to satisfy space requirements. The Thermix Corp., Project Engineers.

ELECTRICAL HEATING UNITS

204—Electric Heaters

Electric unit heaters and heater sections for industrial and commercial heating, as well as for specialized use in heating corners of factories, warehouses, and guardhouses, are described in bulletin E-1. The principal features of three basic types are discussed. Electric duct heater sections for oven-work, drying operations, and similar process heating also are described. Engineering data includes capacity tables and physical dimensions. L. J. Wing Mfg. Co.

205—Far-Infrared Panels

Specifications of Chromalox electric far-infrared radiant panels are detailed in 4-page folder L-1093, for use by Federal, State, and local government purchasing agencies, and others required to purchase by invitation and bid. Items include every component part and characteristic of the panel. The modular panels are assembled into complete infrared ovens, and include full insulation and electric bus. Edwin L. Wiegand Co.

COAL, ASH & BULK HANDLING

206—Conveyer System

How a recently installed interfloor-conveyer system cut receiving-to-storage time is discussed in a reprint. The article tells how the system eliminated a long truck haul, stopped elevator congestion, and reduced unloading time of highway trucks. Included are descriptions of the vertical interfloor conveyer, feeder conveyer, takeaway conveyer, and automatic control system. Gifford-Wood Co.

207—Coal Scale

Described in 16-page bulletin 0352 is an automatic coal scale for weighing coal as it is fed to boilers. Construction and operating details are presented for the belt feeder, the weigh hopper, scale housing, operating levers, and accessories. The booklet also contains an explanation of how the unit operates and information on special features. Richardson Scale Co.

208—Bucket Elevators

Many types of bucket elevators, designed to cover practically any need in elevating loose bulk material, are described in 78-page catalog 850. Applications for each type are discussed, and illustrations show actual installations. Details of construction and dimensions of the units and component parts are presented. The Jeffrey Manufacturing Co.

209—Screw Conveyers

How screw conveyers and screw feeders are used to convey, elevate, heat, cool, and mix many different types of materials is discussed in 92-page booklet 2289. Detailed information, including selection tables, horsepower formulas, layouts, and specifications, aids in selecting equipment for many types of applications. One table lists 250 different materials, classifying them by size, flowability, abrasiveness, and average weight. In addition to helicoid flight and sectional flight conveyer screws, many other types designed for special conditions are discussed. Link-Belt Co.

CONTROLS, REGULATORS & INSTRUMENTS

210—Controllers

Control instruments used to measure and control numerous process variables are the subject of 60-page booklet 1530. Specifications and ratings for both electric and pneumatic type controllers are presented, together with descriptions of the control action. In addition, engineering data on electrical control relays are presented. Industrial Div., Minneapolis-Honeywell Regulator Co.

211—Regulators

"How to Select Regulators," a 40-page booklet, provides useful data for simplifying the selection of pressure regulators, temperature regulators, or pump governors to do a specific job. Steam, gas, and water capacity tables are presented, together with suggestions for installation and other useful information. Foster Engineering Co.

212—Annunciator Systems

How annunciator systems work, and what they consist of, is described in 38-page booklet 100. Component parts of the system are discussed. Considerable information is included to aid in designing. The subject of layouts for hazardous locations also is dealt with. Panalarm Products, Inc.

(Continued on page 132)

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new bulletins

(Continued from page 130)

213—Mass Spectrometer

Announcement of a new mass spectrometer designed primarily to monitor and control continuous processes in chemical plants and oil refineries, is made in 4-page folder CEC-1824. In addition to specifications, subjects such as how it operates and how it is used for process monitoring and control are discussed. Consolidated Engineering Corp.

214—Chemical Feeder Control

Improved processing through automatic control of chemical feeders is described in 4-page data sheet, AED 000-10. Designed for application to the Lapp Pulsafeeder pump, the instrumentation permits automatic feeding of treating chemicals either to maintain uniform concentrations or to correct variations of pH in any continuous process. Separate sections of the folder describe feeder control in relation to flow rate, changing the feed rate by ratio-set mechanism, range of ratio adjustment, and control of pH under varying flow conditions. The Foxboro Co.

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215—Regulating Valves

Valves for controlling the flow of gases and liquids by means of floats, master regulators, or thermostats, are the subject of 12-page bulletin S-22-CA. Specifications, advantages, and construction of diaphragm-operated, spring opening and spring closing regulating valves, pressure controllers, air locks, valve positioners, and selector panels are presented. The Swartwout Co.

216—Liquid Level Gages

Liquid level gages for application on tanks, boilers, stills, or any liquid containing vessel, are the subject of 4-page folder 184. Construction, advantages, and specifications are presented. Also described are reflex gages for special applications. Jerguson Gage & Valve Co.

217—Graphic Panels

To show how graphic panels are used in various industrial applications, photos of actual installations are contained in 4-page folder PI-153. Component parts also are shown. Users in the petroleum industry, chemical and process industries, and power plants are listed. Panellit, Inc.

218—Flow Meter

Subject of 12-page bulletin 380-G2A is a propeller-type totalizing flow meter with a direct-reading counter. How this unit can be used as a totalizer-indicator-recorder to transmit information to remote points is described. An alarm register also is presented for use on batch operations. A useful engineering information section is provided. Builders-Providence, Inc.

DIESEL & ENGINE ACCESSORIES

219—Cylinder Liners

"Water Side Deterioration of Diesel Engine Cylinder Liners," 8-page reprint, deals with problems in water cooling of diesel

engines. Reasons are given for failure of protective measures to stand up in service, and certain steps are outlined that may be expected to provide effective remedies. Illustrations supplement the text. The International Nickel Co.

ELECTRICAL DISTRIBUTION

220—Power Conversion Units

Metallic rectifier power conversion units are the subject of 8-page bulletin GEA-5658B. The publication lists design features, advantages, descriptions, performance, circuits, and ratings for units from 125 to 250 v d-c. A guide also is provided as an aid in preparing contract specifications which entail d-c power supplies and exciters. Drawings show outline dimensions. General Electric Co.

221—Circuit Breaker

Design and construction of a magnetic air circuit breaker arranged for installation in vertical lift switch gear rated 4.16 kv is described in 4-page folder 18B6346B. How the unit interrupts short circuit current is explained. Ratings and dimensions are listed in tables. Allis-Chalmers Manufacturing Co.

ELECTRICAL INSULATION

222—Asbestos Insulation

Information about electrical insulations made of purified asbestos—why they were developed, what their characteristics are, and where they may be used to advantage—is contained in 32-page booklet EL-40A. Tables give test data on physical and electrical properties. Illustrations show application techniques and advantages. Literature suggests applications for core tubes, layer insulation, layer wrapping, interlaminant insulation, end washers, and final wrapper insulation. Johns-Manville.

ENGINES

223—Gas Engines

Spark-fired, 4-cycle gas engines are the subject of 4-page folder 221. Advantages and construction are described. A table lists 9 and 13 in. bore sizes ranging from 265 to 4260 hp in non-supercharged, supercharged, supercharged and intercooled, and Supairthermal types. Nordberg Mfg. Co.

FILTERS, STRAINERS & PURIFIERS

224—Line Type Filters

How mechanical separators reduce costs by removing such entrainment as dirt, solids and moisture from steam, vapor, compressed air, and gases is explained in 8-page bulletin 501. Diagrams show how small line type purifiers are installed. Suggested applications, advantages, specifications, and selection data are outlined. The V. D. Anderson Co.

FUELS AND FIRING EQUIPMENT

225—Over-Fire Air Systems

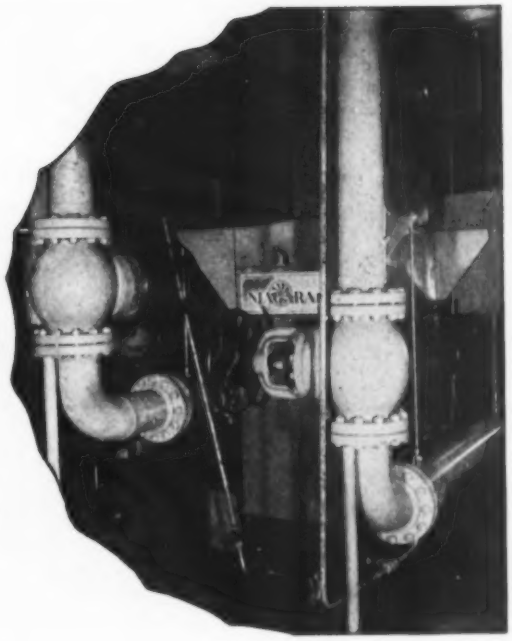
"Smoke is Wasted Fuel," a 4-page folder, describes how over-fire air systems operate. How an automatic control with electric eye can be applied to the systems is explained. Instructions on how to select the proper size are presented, together with a selection chart and a table of fan data and characteristics. Canton Stoker Corp.

226—Oil Burning Equipment

Oil burners, combination gas and oil burners, oil pumps, and accessories are described in 20-page booklet 3048. Subjects such as how to select a burner, engineering and manufacturing factors, construction features, principles of operation, typi-

(Continued on page 134)

How to get drier or cooler air or gases . . .



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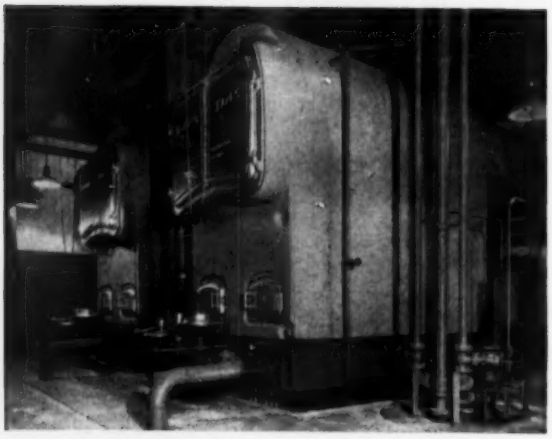

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new bulletins

(Continued from page 133)

cal installations, basic firing operation, automatic operation, and use of panel or control boards are presented. Engineers concerned with selection of firing equipment should find considerable information of value in this booklet. Petro Div.

HEATING, AIR CONDITIONING, & VENTILATION

227—Roof Ventilators

Various types of power roof ventilators are described in 16-page bulletin 3704. In addition to discussions of the applications and construction, such engineering information as performance data and dimensions are presented. To aid in selection, tables of steam heating capacities, fan capacities, steam conversion factors, and air friction of coils and filters are presented. American Blower Corp.

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228—General Catalog

Equipment for buildings and institutions is the subject of 20-page bulletin WP-1099-B27M. Condensed information is provided on such equipment as air conditioning and refrigeration products; oil, gas, and dual fuel engines; deaerators and deaerating heaters; water conditioning; steam turbines and turbine generators; liquid meters; centrifugal pumps; regenerative turbine pumps; vertical turbine pump; and multi-V drives. Worthington Corp.

MECHANICAL POWER TRANSMISSION

229—V-Belts

Fractional horsepower V-belts, for use in servicing light duty applications, are listed according to the new industry-standard numbering system in a new catalog. Various types of machines are listed alphabetically by company or trade-names for convenience in determining the proper belt. Manhattan Rubber Div., Raybestos-Manhattan, Inc.

230—Gear Drives

How to select herringbone gear drives is explained in the engineering data section of 40-page booklet 2519. Tables list ratings, overhung loads, and specifications. Construction, applications, and advantages of single, double, and triple reduction enclosed herringbone gear drives are presented. Units are listed in standard ratios from 2.84:1 to 326:1. Capacities range from 0.4 to 2480 hp, and output shaft speeds range from 2.2 to 623 rpm. Link-Belt Co.

231—Gear Couplings

Advantages of flexible gear couplings are described in 16-page brochure C 4. The construction of many types, including standard, mill motor, vertical shaft, floating shaft, and spacer types is discussed. Typical installations and specifications also are presented. A useful engineering data section provides information on installation,

(Continued on page 136)

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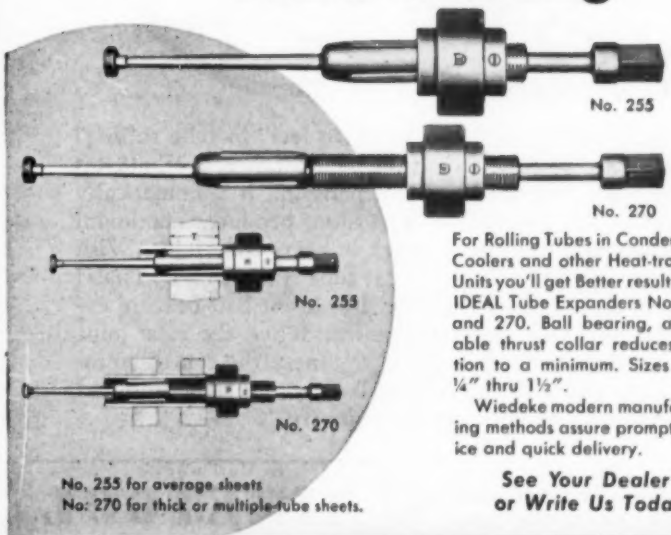

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new bulletins

(Continued from page 134)

lubrication, selection, bore tolerances, recommended keyways, and service factors. Sier-Bath Gear & Pump Co., Inc.

232—V-Belts

Advantages of a high capacity V-belt are outlined in 4-page folder 20B7786. This type of V-belt is recommended for use in tight spots, for changed peak loads, for resisting oil, weather, and chemicals, for cutting sheave costs, and where static is a factor. Allis-Chalmers Manufacturing Co.

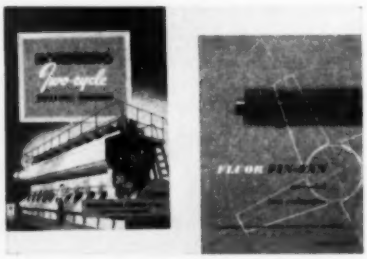
DIESELS

233—Diesel Engines

To show the simplicity of diesel engine construction and to provide an understanding of the operation, "What You Should Know About Diesel Engines", 28-pages, is written in a non-technical style. Comparisons are made between diesels and gasoline engines, and between 2-cycle and 4-cycle diesels. Latest advancements are discussed. P & H Diesel Div., Harnischfeger Corp.

234—Dual Fuel Engines

One of the interesting features of 16-page bulletin 202 is a schematic diagram of a dual fuel engine, showing starting air, fuel oil, pilot oil, and gas lines. Operation, advantages, and construction also are described. Descriptive data on the pilot oil injection system, hydraulically actuated gas valves, forced feed lubrication, and positive action safety devices are presented. Nordberg Manufacturing Co.



HEAT EXCHANGER EQUIPMENT

235—Air-Cooled Heat Exhangers

Forced draft, air-cooled heat exchangers, for a wide variety of industrial cooling and condensing applications, are discussed in 12-page bulletin FF-FD-0.001. How they operate, construction, and design features are discussed. Data on heat transfer, horsepower, and space requirements are included in a discussion of applications. The Fluor Corp., Ltd.

236—Condenser Tube Inserts

How to restore leaking condenser tubes to service by sealing off the deteriorated portion with inserts, is the subject of 4-page folder 500. The booklet also describes installation and advantages. Tube cleaners, expanders, and maintenance tools also are listed. Thomas C. Wilson, Inc.

237—Heat Transfer Equipment

Various types of heat transfer equipment are listed in 8-page bulletin 945. Included are heat exchangers, heaters, coolers, coils and bends of pipe and tubing, pressure vessels, and prefabricated plate products. Brief descriptions of each product are presented. The Whitlock Manufacturing Co.

MOTORS & GENERATORS

238—Motor Maintenance

Listed in 64-page general catalog 29 is equipment for the maintenance of commutators, motors, and electrical distribution systems. A brief description and useful information on each product is presented. In addition, products such as production equipment, safety equipment, and tools for mechanical maintenance are presented. Martindale Electric Co.

239—Motor Controls

"Quality Line of Motor Controls for All Industries," 28-page booklet, describes standard motor control apparatus including controls, starters, and accessories. Construction, advantages, and applications are listed. Allen-Bradley Co.

240—Drive Equipment

Auxiliary drive equipment for rolling mills is the subject of 12-page bulletin GEA-5570. Special emphasis is placed on the importance of sound auxiliary drive systems in helping increase the tonnage of steel mills. Outstanding features of specific installations in blooming and slabbing mills, hot-strip mills, and cold-strip mills are described. Also discussed is the application of magnetic loop controls, tensiometers, x-ray thickness gages, and steel-mill width gages. General Electric Co.

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241—Magnetic Motor Starters

Magnetic motor starters with vertical overloads below contactor are described in 8-page bulletin 4529-26. They are manufactured especially for petroleum, chemical, petro-chemical, and other related industries. Advantages and construction are discussed, and principal dimensions are listed. Industrial Control Div., The Arrow-Hart & Hegeman Electric Co.

PIPE, TUBING & HOSE

242—Pipe & Tubing

One of the alloy tubing steels widely used in elevated temperature service is discussed in 4-page folder TDC-146. The mechanical properties of annealed and heat treated types, physical properties, and maximum allowable working pressures are tabulated. Fabrication also is discussed. Tubular Products Div., The Babcock & Wilcox Co.

243—Plastic Pipe

Procedure for the installation of flexible plastic pipe is described in a technical data sheet.. Various types of available fittings also are depicted. Answers to the most frequently asked questions present the reader with the most important facts concerning installation, application, and specifications. Carlon Products Corp.

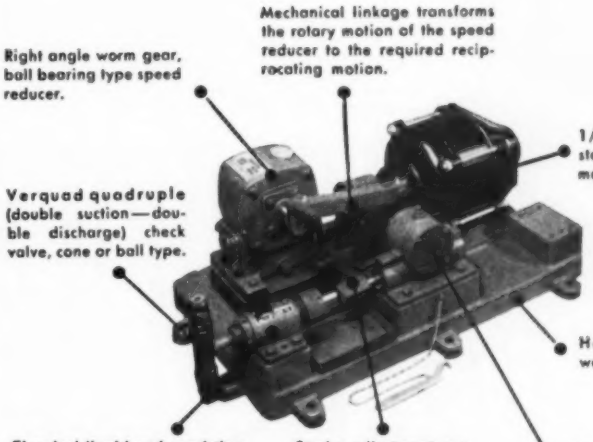
THERMAL INSULATION

244—Spray-Applied Insulation

Degree of protection from condensation which is afforded by a spray-applied cork and mastic insulation, is shown in a series of charts. The coating is described as providing moderate insulation as well as protection from corrosion. Recommended applications include protection of heated storage tanks, and control of condensation on cold pipes and vessels. Charts give

(Continued on page 138)

Simplicity of design plus precision manufacture


Right angle worm gear, ball bearing type speed reducer.
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1/3 or ½ H.P. high starting torque electric motor.
Verquad quadruple (double suction—double discharge) check valve, cone or ball type.
Heavy ribbed and webbed cast iron base.
Chemical liquid end consisting of interchangeable barrel and housing assembly containing the plunger, packing and packing gland.
Stroke adjustment coupling. Stroke adjustment WHILE PUMP IS IN OPERATION is optional.
Sealed-in-oil precision rack and pinion assembly drives the plunger in the liquid end.

assure high standards of accuracy and dependability in Hills-McCanna "U" type metering and proportioning pumps

Whenever small volume flows must be metered or proportioned continuously, the simple, foolproof design of Hills-McCanna "U" Type Pumps pays big dividends. For flows up to 24 gallons per hour per feed, its accuracy and reliability suit it for research, pilot plant operation and full scale processing alike.

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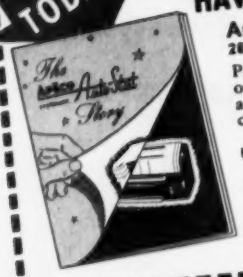

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new bulletins

(Continued from page 137)

dew point for uninsulated pipe and for surfaces with ¼ and ⅜ in. sprayed insulation. Surface temperature of the insulation also is tabulated. Insul-Mastic Corporation of America.

245—Insulation Surfacing

Fire-retardant surfacing, designed to provide maximum resistance to mechanical abuse regardless of the insulating materials used, is briefly described in a catalog sheet. Photos show actual use on ducts, pipes, and tanks. The material is designed primarily for use with lagging cloth. Benjamin Foster Co.

SOOT BLOWERS & TUBE CLEANERS

246—Automatic Soot Blowers

"Some Outstanding Automatic-Sequential Soot Blower Installations in Central Stations," 32-page bulletin 1004, discusses actual case histories. Power and reheat boilers with capacities to 1,370,000 lb per hr, pressures to 1925 psi, and temperatures to 1055 F are included. Blowing medium is steam or air, and units are power-driven by air or electric motor. Copes-Vulcan Div., Continental Foundry & Machine Co.

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PACKAGED STEAM GENERATORS

247—Packaged Automatic Boilers

Featured in 12-page bulletin 1218 is a cut-away view showing design of a packaged automatic boiler. Component parts, performance, advantages, and types of equipment also are discussed. Units are equipped with air atomizing oil and free-mix gas burners, which can be quickly converted from oil to gas or from gas to oil without additional piping of wiring. Ratings from 15 to 500 bhp are listed. Orr & Sembower, Inc.

248—Automatic Boilers

Data and specifications for packaged automatic boilers from 20 to 500 bhp are listed in 4-page folder 102. Design features and advantages are discussed. Combination oil and gas burners are described. Boiler Engineering & Supply Co., Inc.

249—Oil & Gas Fired Units

Important features of a self-contained, completely equipped, steam generating unit are outlined in 8-page bulletin 508. Units are listed for oil, gas, or combination oil and gas firing. Installation is discussed, and typical examples are illustrated. Johnston Brothers, Inc.

PUMPS

250—Rotary Gear Pumps

"How to Solve Pumping Problems," is the title of 36-page booklet 3060. In addition to presenting typical problems and their solutions, various types of rotary gear pumps are described. The major portion of the book is intended to serve as a data

(Continued on page 140)

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EXCLUSIVE DESIGN—

Single seated, tight closing, non-sticking. Large, diaphragm, sensitive pressure adjustment. Compact, rugged, self-contained.

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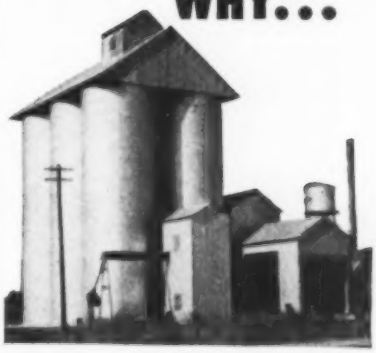

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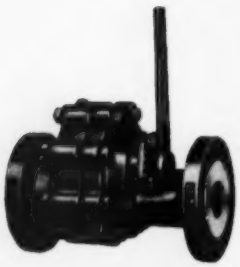

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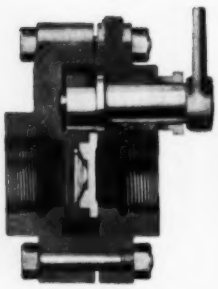

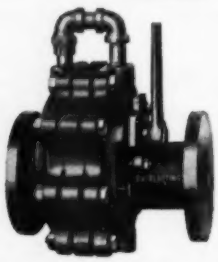

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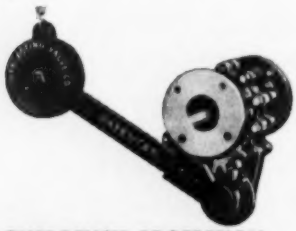

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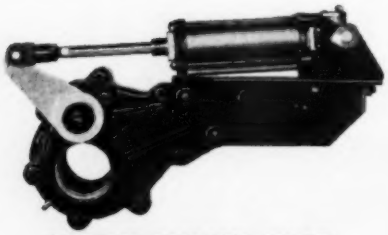
Closing type for inflammable liquid emergency shut-off, or opening type for deluge or drainage, assuring immediate and positive action with weighted pendulum stop.



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Quick Action... opened or closed with less than a quarter turn of the operating lever.

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FOR EVERLASTING PROTECTION

new bulletins

(Continued from page 138)

handbook. Nomographs of friction loss in pipe, resistance of valves and fittings, and viscosity of oils are included. Tables list viscosities and specific gravities, conversion tables, electrical data, and construction materials. Geo. D. Roper Corp.

251—Rotary Pumps

Heavy duty rotary pumps are the subject of 16-page bulletin W-483-B2. Construction and specifications are given for herringbone gear types with capacities to 5000 gpm and pressures to 500 psi, and a sliding-vane type rated to 100 gpm and 200 psi. Fields of application are tabulated, and typical driving arrangements are shown. A useful data section includes a viscosity conversion table, the relation of A.P.I. hydrometer scale to specific gravity, and a viscosity-temperature chart for fuel oils. Reciprocating Pump Div., Worthington Corp.

252—Opposed Impeller Pump

How opposed impellers balance axial thrust is described in 12-page brochure 1502. Sizes from 2 to 4 in., with 2 to 8 stages, are presented for capacities to 1000 gpm, pressures to 1200 psig, and temperatures to 350 F. Design features, and their importance, are discussed. Typical applications are tabulated. De Laval Steam Turbine Co.

253—Centrifugal Pumps

"How to Figure Pumping Head," is a particularly useful section of 24-page bulletin 08B614B. Construction features of single-stage, double-suction centrifugal pumps are discussed, and applications are suggested. Various types of drives also are listed. In addition, the booklet contains tables of available sizes, approximate dimensions and head capacities, and tabulates friction loss of water per 100 ft of pipe. Allis-Chalmers Manufacturing Co.

254—Multi-Stage Pumps

Pumps for supplying, circulating, and boosting water and process liquids are described in 12-page brochure B-1400. Specifications are tabulated, and construction is described for 2, 3, 4 and 5 stage split-case units. Capacities up to 3000 gpm, and heads to 1550 ft are listed. Peerless Pump Div., Food Machinery and Chemical Corp.

VALVES

255—Solenoid Valve

New design principles applied to solenoid valves to increase and extend the efficiency and scope of operation, are described in a 12-page brochure. Construction, advantages, and typical applications are listed. A cable shows pressure drop vs. fluid flow. Valcor Engineering Corp.

256—Engine Stop Valve

Automatic shut-down of turbine, compressor, or engine in event of over-speeding, is provided by a combined throttle and engine stop valve described in 6-page folder S-3. Applications, fabrication, installation, and design, along with a complete parts list, dimensions, and specifications, are presented. Golden-Anderson Valve Specialty Co.

257—Cast Steel Valves

To aid engineers in the selection of valves, 56-page booklet 12-C contains useful information on material specifications, preparation of welding ends, flange facings, and pressure-temperature ratings. Construction and specifications for globe, angle, and check valves in 300, 600, 900, and 1500 lb pressure classes are given. Also discussed are parabolic disk valves for hand or motor control of volume. Edward Valves, Inc.

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258—Solenoid Pilot Valve

Advantages and construction features of solenoid pilot valves for handling air, vacuum, oil, water, and inert gases are contained in 4-page folder PB. Listed in a table are 2-way and 3-way units for normally closed or normally open operation, with orifice sizes from 1/16 to 1/8 in. for operation on 110, 220, or 440 v, 60 c current. Valvair Corp.

259—Valves & Fittings

Described in 16-page catalog 801 are a series of valves and fittings designed expressly for service with anhydrous ammonia or other gases that are non-corrosive to steel. Descriptions and specifications are presented. Henry Valve Co.

260—High Pressure Valves

Electrically operated high pressure valves, offered in sizes from ½ to 1½ in. and for pressures to 3000 psi, are the subject of a 4-page folder. Design, application, sizes and operation are discussed. Diagrams show circuits for normally closed and normally open operation. Atkomatic Valve Co.

261—Air Valves

Valves for operating single or double acting air and hydraulic cylinders, and air motors, are described in 16-page catalog 1000. Hand, foot, power, and solenoid operated models are listed in sizes from ⅛ to 1¼ in. Illustrations, operating and circuit diagrams, and specifications are presented. Ledeen Manufacturing Co.

262—Diaphragm Motor Valves

Specifications of diaphragm motor valves for narrow band proportional control are tabulated in 4-page specification sheet 419-2. Such data as size, construction, body pressure range, connections, and complete mounting dimensions are presented. Industrial Div., Minneapolis-Honeywell Regulator Co.

WATER TREATMENT

263—Demineralizers

Construction of a single column, fully automatic demineralizer is discussed in a data sheet. Component parts and perform-

(Continued on page 142)

Matchless for Bonding and Patching Refractory Brick & Shapes

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BONDS STRONGER

LASTS LONGER

That "Wonder Cement" For Better Resistance to Flame Erosion, Abrasion, Spalling

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Super #3000 is a plastic refractory mortar of patching consistency which, when mixed with water, is readily troweled, brushed or sprayed. It air-sets to flint-like hardness, bonding fire brick, tile or other refractory sections air tight with strong joints that outlast the refractories it bonds — at high or low temperatures.

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Because of its extraordinary resistance to abrasion, especially the scouring action of hot particle-laden gases or fly ash, Super #3000 — when brushed or sprayed on — adds greatly to the life of refractories.

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new bulletins

(Continued from page 141)

ance are described, and specifications are listed in a table. Penfield Manufacturing Co., Inc.

264—Chemical Feeder

Construction and advantages of a heavy duty, positive displacement, diaphragm pump, designed to feed corrosive fluids used in industrial processes and in treating water and sewage, are discussed in 4-page folder 1201. A table lists a few of the chemical solutions and concentrations that can be handled. Operating data and a performance curve also are presented. %Proportioneers, Inc.%

265—Chemical Feeders

Tabulated in 8-page products index B-I-F 3 are chemical handling products of three manufacturers. Included are units for automatic treating, feeding, diluting, blending, proportioning, and sampling, as well as a wide variety of instruments for metering and controlling flow, liquid level, temperature, pressure, and weight. In addition, volumetric and gravimetric feeders for dry materials and feeding liquids by gravity are listed. A bulletin containing more complete details is listed for each product. B-I-F Industries, P.O. Box 1342, Providence 1, R. I.

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Boiler plant operators of high speed centrifugal boiler feed pumps have long been looking for a satisfactory packing for these important units. Speeds have advanced from 1750 rpm. in 1910 to 5000 rpm. today, with shafts ranging up to 3½" diameter. Handling hot condensates up to 430°F. and pressures to 1250 psi. are no longer uncommon. High speed centrifugal boiler feed pumps go into service with lightning speed. The friction heats ordinary packing in a very short time. The oil and lubricants in these packings are boiled out and the asbestos seizes around the pump sleeves. Extensive damage and costly shutdowns result.

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Operating engineers prefer "JOHN CRANE" Super Seal No. 1 for high speed centrifugal boiler pump service. Supplied in spirals, coils and die-formed rings and sets to fit all stuffing boxes.

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TRANSFORMERS

266—Instrument Transformers

"Instrument Transformer Buyer's Guide", 102-pages, is designed for saving time in selecting and ordering current transformers, potential transformers, and metering equipment. Ratings and ASA accuracy classifications are tabulated for indoor and outdoor units. Listings of ratio and phase-angle tests, together with tables covering the mechanical and thermal limits of current transformers, are included. General Electric Co.

WELDING EQUIPMENT

267—Welding Design

"How to Shape Steel for Low Costs," 6-page folder 843B, presents many useful ideas on the elements of welding design. Actual cost figures are presented with the examples to serve as a means of comparison. Engineering drawings supplement the text. The Lincoln Electric Co.

268—Arc-Welding Accessories

Arc-welding accessories are described in 12-page booklet B-5451. Products vary from electrode holders and ground clamps to protective clothing and headgear. Specifications and illustrations are given, and special application characteristics are discussed. Westinghouse Electric Corp.

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269—Stainless Steel Welding

Information on stainless steel wire for both automatic inert gas welding and manual gas welding, as well as metalizing, is contained in a folder. Descriptions of wire and equipment for welding of stainless steels are provided. Information on wire sizing, temper, spooling, tolerances, and equipment also is included. Alloy Metal Wire Co., Inc.

MISCELLANEOUS

270—Hardening Furnaces

Gas-fired, batch type hardening furnaces are the subject of 4-page folder SC-161. Direct-fired, horizontal hearth types and circular and rectangular salt pot types are included. Also shown is a line of controlled atmosphere equipment for hardening. A useful temperature conversion graph is presented. Surface Combustion Corp.

271—Shielding Rooms

Described in an 8-page brochure are rooms developed to suppress R-F interference caused by testing of electrical and electronic equipment. A variety of types and sizes are listed, including a double shield, multiple cell type, a double shield, isolated cell type, and a single shield type. Construction details and installation are discussed. Shielding, Inc.

272—Fluorescent Lamps

How to select the proper fluorescent lamp for a particular industrial or commercial application is explained in 24-page pocket catalog B-5799. Features and specifications for a wide variety of lamp types are presented, and a table provides convenient access to standard data on each type. Westinghouse Electric Corp.

—*End*

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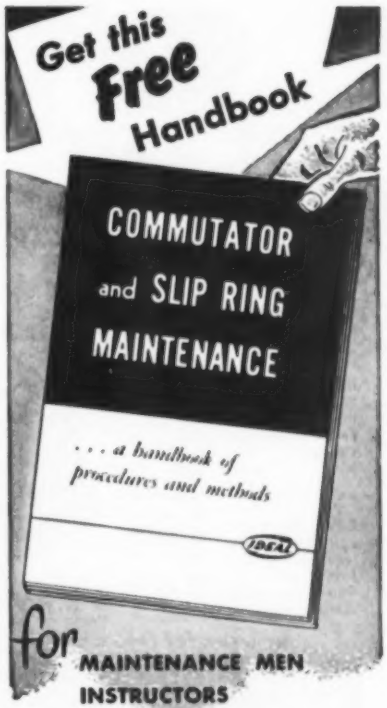

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Even if you do not have a regular maintenance training program, your people responsible for motor and generator maintenance need, and will do a better job, with the help of this handbook.

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A watchdog keeps undesirable people from your door; a pipe strainer keeps harmful rust and scale from equipment and control accessories. An Armstrong Y-Type strainer is an efficient "watchdog" in any pipe line—steam, air, gas, water or oil.

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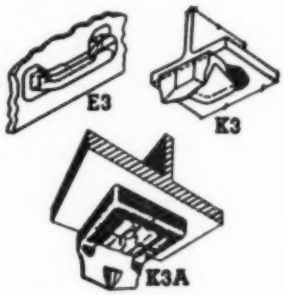

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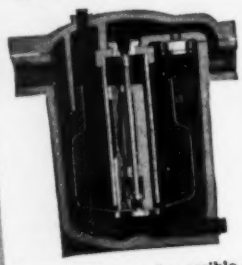

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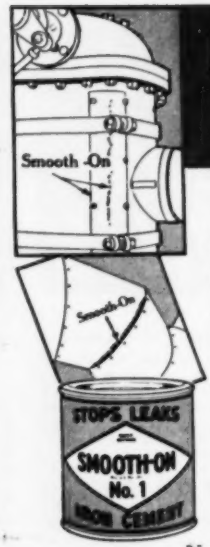

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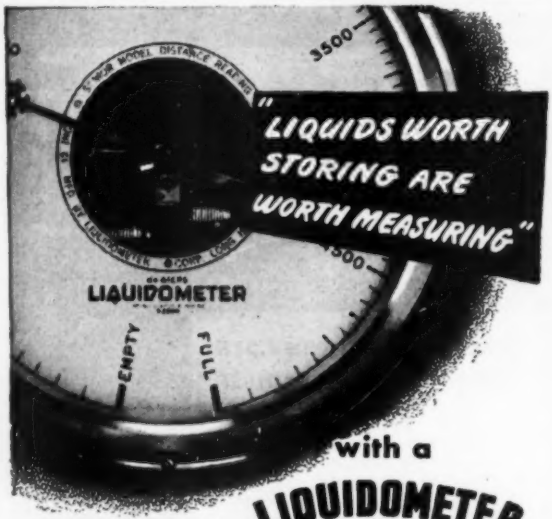

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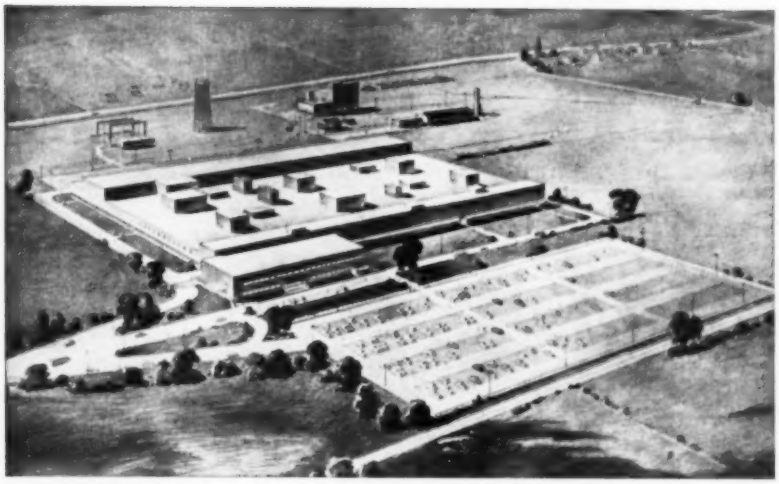
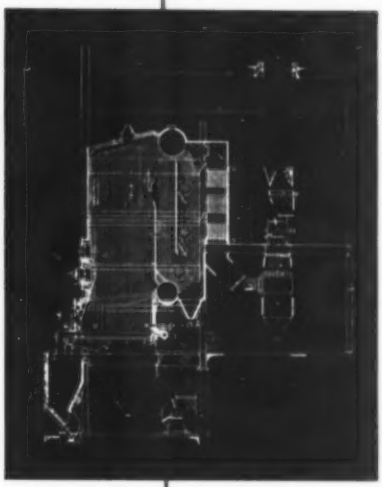


CONTRACTORS: Consolidated Engineering Company Inc., Baltimore, Md.
CONSULTING ENGINEERS: Whitman, Requardt & Associates, Baltimore, Md.



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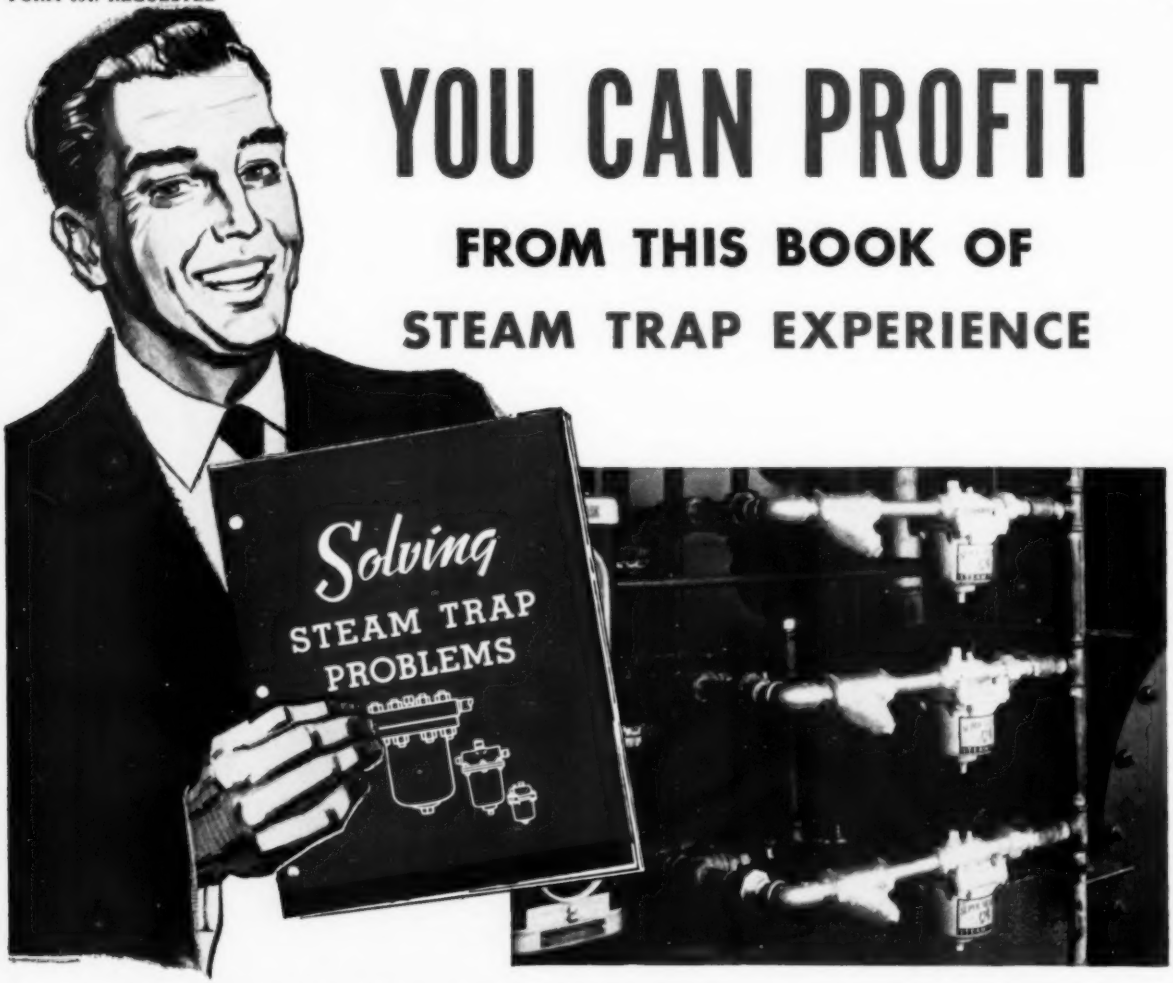

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